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# The Canadian Engineer

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## The Canadian Engineer

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## VOLUME XVII.

With this issue we commence a new volume. In last week's issue appeared a complete index of the first twenty-six issues of this year. It will be found to cover the engineering problems that have to be faced in Canada and when bound with Volume XVI. will be a great aid in reference work.

The size of the journal has been so increased that semi-annual volumes are necessary. The support the journal is receiving from subscribers and advertisers is so generous that we can promise more interesting articles, fuller market reports, and a more complete news service than formerly.

## FREIGHT TRAIN LOADS.

The record for hauling large freight trains was made by a Pennsylvania railroad last month, when it drew 4,451 tons of coal 124 miles in 7 hours and 15 minutes. The train consisted of an engine and tender, weighing 241,000 pounds; 85 steel gondola cars and a caboose, the total weight being 6,151 tons, and the length of train was 3,000 feet, or almost three-fifths of a mile.

Previous to this the company had made other tests over the same line. The results were as follows:—

| No. | No. of cars. | Total weight of train, tons. | Time. Hrs. | Min. |
|---|---|---|---|---|
| 1 | 75 steel | 5,307 | 10 | 21 |
| 2 | 75 " | 5,348 | 8 | 2 |
| 3 | 75 " | 5,348 | 10 | 12 |
| 4 | 85 mixed | 4,852 | 12 | 30 |
| 5 | 86 " | 4,922 | 9 | 42 |
| 6 | 87 " | 4,623 | 10 | 21 |

These runs were made over a section on which grades were reduced to 0.2 per cent. compensated for curvature.

The figures give some idea of the volume of freight a modern railway can handle, and bring the railway and canal in closer competition.

## A NEW ROAD COVERING.

From Minnesota comes information of a new method of road-making. In certain sections of the State the highway soil was very sandy, and to make passable roads the highway engineer employed clover and sawdust.

Along the roadside and on the shoulders of the road clover and rye were sown. This grew and prevented the blowing of the sand. Then at intervals the clover and rye were cut and thrown on the travelled part of the road allowance. Sometimes sawdust was added, and as the material rotted and worked up with the sand the highway became firmer, and it could be graded like a loam road.

On another strip four inches of sawdust was spread, and this, too, made a good road.

## THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The Canadian Society of Civil Engineers held their annual excursion on June 24th to Detroit. The journey was interesting. The works examined at Walkerville, Windsor and Detroit were very instructive.

It is a wonder more engineers do not avail themselves of the opportunity such trips afford of becoming acquainted with their fellow-engineers.

## RAILWAY ACCIDENTS.

In this issue will be found a list of accidents that occurred on the steam and electric railways of Canada during June, 1909.

It is just possible that the list is not complete, but as we enlarge upon the work our list will become more accurate.

Our purpose in preparing this list is to have at hand the information that will enable us to classify accidents according to cause with the hope that with publicity will come education, and thus a lessening of accidents.

## EDITORIAL NOTES.

"Principles Governing the Compression of Air and Some Notes on its Uses" is the title of a paper to be read before the Engineers' Club of Toronto on Monday evening, July 5th, at 8.15, by Mr. William Reavell, M. Inst. M.E., M. Inst. C.E., etc., of Ipswich, England. Mr. Reavell is recognized as an authority on air compressors, and his address will be of interest to all.

* * * *

The Dominion Steel Company's statement, issued June 16th, was very favorable, even though the year's earnings (which show a net surplus of $1,571,412) are less than last year's. The operations of the twelve-month, after paying all expenses except interest, and after providing for sinking fund, depreciation and renewal of plant, show a profit of $2,225,834. Profit and loss was credited in March last with $2,209,210, transferred from contingent account in connection with the claim against the Coal Company, and the Steel Company directors have appropriated $1,800,000 of this in reduction of property and construction account. The reports of the English engineers, Messrs. Harbord and Hall, on the company's supply of coal, ore and other materials at Bell Island, Wabana, Marble Mountain and Sydney are very commendatory.

For the eleven months ending May 31st, the net earnings of the Canadian Northern were $2,562,900, against $2,272,200 last year, and $1,785,100 in 1907.

## RAILROAD ACCIDENTS

### Summary of Casualties in Canada During June.

### Thirty Killed—Many Injured—Neglect Cause of Many Fatalities.

June 1st.—At Myrtle, Ont., C.P.R. fireman William E. Reid was struck by a waterspout, whilst leaning out of the cab, and killed.

At Emery, Ont., James Duncan, of Emery, was cut to pieces by a C.P.R. passenger train. He attempted to cross in front of a C.P.R. express.

At Parry Sound, Ont., the flange of a C.P.R. freight car wheel broke and several cars left the rails. Train crew sustained slight injuries and traffic was delayed several hours.

At Smith's Falls, Ont., C.P.R. Engineer Bennett, of Havelock, was badly scalded. Cause, boiler of engine drawing Montreal express burst.

At Halifax, N.S., James B. Anderson, aged five years, killed by street car, whilst crossing tracks.

At London, Ont., Vincent Famulara, age 1½ years, run over by street car and seriously injured.

At Missanabie, Ont., C.P.R. Atlantic Express derailed. Cause, broken wheel; delay, five hours.

At Hobon, Ont., C.P.R. Imperial, Limited ran into open switch, instantly killing an unknown tramp who was stealing a ride, injuring the engineer, and damaging the engine and mail car. Delay, three hours.

At Quebec an I.C.R. brakeman named Anctil, of Fraserville, took a fit whilst walking on track and was killed by a passenger train.

June 2.—At Brockville, Ont., a G.T.R. manifest train was wrecked, causing much damage to track and rolling stock, and blocking both lines for seven hours.

At Point aux Trembles, Que., Joseph L. Benoit, a C.N.R. brakeman was killed whilst shunting cars. Missed footing in attempt to board engine and crushed by tender.

At Thornhill, Ont., a C.N.R. passenger train was derailed and delayed traffic several hours.

June 3.—At Galt, Harry Drinkwater, knitter, very deaf, wheeling across track, killed by G. P. & H. car.

June 4.—Near Ingersoll, G.T.R. flyer derailed; two injured; cause, washout in track.

At West Toronto, Ont., Duncan Reid, a miller, of Streetsville, Ont., tried to board moving C.P.R. train, fell beneath wheels and lost left arm.

June 5.—At Ottawa, Ont., Leslie Stanley, aged 7, run over and killed by street car.

June 7.—At Toronto, Ralph Jasper, 12, foot caught in switch, crushed by car which was being shunted.

At Montreal, a Syrian woman struck by street car sustained slight injuries.

June 9.—At Grandes Piles, Que., C.P.R. engineer killed in head-on collision between local pilgrimage train.

At North Sydney, N.S., 16 cars of coal left tracks and damaged badly; 200 feet of track torn up. Cause, spreading rails. None of train crew injured.

June 10.—At Vancouver, B.C., two G.N. express trains collided head-on, killing two engineers and a fireman and injuring three passengers and three train hands.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of June 21 | | STOCK QUOTATIONS TORONTO | | | | STOCK QUOTATIONS MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price June 25 '08 | Price June 17 '09 | Price June 24 '09 | Sales Week End'd Jun. 24 | Price June 25 '08 | Price June 17 09 | Price June 24 '09 | Sales Week End'd Jun 24 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,481 000 | 1,287,000 | 159 | | 181¾ | 56 | 160 | 159¾ | 181 | 182¾ 182½ |
| Canadian Northern Railway | 2,986.9 | | | 184,500 | 151,200 | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 826,865 | 818,672 | | | *1st. pref. 106, 3rd pref. 56½, ordinary 23¾ | | | | | |
| T. & N. O | 334 | (Gov. Road) | | 24,101 | 16,656 | | | | | | | | |
| Montreal Street Railway | 138 3 | 18,000 | 100 | 86,575 | 74,764 | | | | | 178 | 177¾ | 218 | 217 218 217¾ 405 |
| Toronto Street Railway | 114 | 8,000 | 100 | 79.709 | 70,307 | | | 123¾ | | 99 98¾ | 98 | 124¾ | 124½ 121 123¼ 605 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 157 | 189 | 185 | | 85 159 | 158 | | 185 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

At West Lorne, Ont., Peter Welsh, a sectionman, struck by M.C.R. express and instantly killed. Stepped from other track out of road of freight train.

At Dalton, Ont., two C.P.R. work trains met in a head-on collision, killing a train hand and seriously injuring the trainmaster. Cause, mistaken signals.

At Newtonville, Ont., G.T.R. passenger engine and baggage car left rails. Nobody injured. Cause, broken rail.

June 11.—At Brampton, Ont., Joshua Moddison, badly injured by C.P.R. express whilst walking on track. He is quite deaf and did not hear train approaching.

June 12.—At Toronto, a street car trailer left rails and collided with a sprinkler on other track, injuring five, none seriously.

At Cobalt, a man was found on T. & N.O. tracks with both legs severed. He died later.

At St. Therese, Que., a young man named Paquette jumped from a C.P.R. train travelling 35 miles an hour, followed by his father. The son died some hours later; the father will probably live.

At St. Jerome, Que.—A two year old child crawled on the tracks and was killed by a C.P.R. passenger train.

Near Hamilton, on the Hamilton and Dundas electric line, a trolley car was derailed and several passengers sustained injuries.

Near Port Hope the G.T.R. express train from Toronto to Montreal left the rails. No passengers were seriously hurt. Four hundred yards of track were torn up. Probable cause, watersprings undermined track.

At Toronto, Mrs. Crawford was alighting from a street car and fell to the pavement, sustaining slight injuries. Mrs. McKenzie had a similar experience.

Near Whitby, several G.T.R. freight cars in a train of 50 left the rails.

June 17.—Near Viscount, Sask., a freight train was wrecked and several cars left the rails.

June 17.—At Ottawa, Ont., Paul Brennan, G.T.R. yard-master, was instantly killed. He fell off the footboard of a shunting engine under the wheels.

June 18.—At Russell, Man., C.N.R. engine No. 100 and construction train left the tracks, turned over on her side and pinned the engineer between the engine and tenders, badly injuring one of his legs. Cause, spreading of skeleton tracks.

At Winnipeg, Man., Mrs. Alex. MacDonald was run over by a street car trailer and injured.

June 19.—At Hamilton, Ont., a street car jumped the track, injuring two passengers.

June 20.—On the Chipman-Moncton, N.B., section of the G.T.P., a supply train ran away and jumped the track, killing two and injuring two more, whose recovery is doubtful.

June 21.—At London, Ont.—William Clark, a G.T.R. crossing watchman, struck by engine and badly shaken up.

June 22.—At Toronto, Patrick McGovern attempted to board a moving train. He fell under the wheels of a car and a portion of his left foot had to be amputated.

At New Westminster, B.C., a G.N. engine left tracks and plunged into the Fraser River. Engineer and fireman were drowned. Cause, open switch.

June 22.—At Winnipeg, Man., Thomas Young was struck by a street car and died a few hours later.

At Ottawa, a boy who was struck by a street car was compelled to have his leg amputated.

June 24.—At Haileybury, Ont., an express from Toronto ran into a siding through a misplaced switch. Damage to rolling stock only.

At Toronto, three women were injured whilst alighting from street cars.

June 25.—At Kenora, Ont., Robert Neilly, a C.P.R. brakeman, caught his foot in a frog and was knocked down by a passing train. He will probably die.

At Gravenhurst, Ont., Harry Kinsella, aged 26, was killed in the G.T.R. yards whilst crawling under a freight train.

June 28th.—At Nothchill, B.C.—five laborers were killed in a freight wreck, caused by broken flange. A sixth was seriously injured. All were stealing a ride.

At Georgetown Junction, Ont., a man named Steven was killed by a passenger train whilst driving across tracks.

At Montreal, Paul Struble, 11, was knocked down by a street car and slightly injured.

Near East Toronto, Charles Wright, a driver, crossed the G.T.R. tracks at an unprotected level crossing after a freight train going east had passed. The Montreal express, west bound, came along, killed his horse and smashed the wagon to pieces. Wright was rendered unconscious but recovered shortly after.

Near Hull, Que., Alphonse Laroque, run over by C.P.R. gravel train; left foot and thumb cut off.

June 29.—Near North Bay, Ont., a C.P.R. freight train was wrecked and 25 cars ditched; five hundred yards of track were torn up and five cars completely destroyed. Train hands escaped injury.

## DESIGN OF ELEVATED TANKS AND STAND-PIPES.*

O. E. Selby.

This paper presents a desirable addition to the list of standard engineering specifications. Heretofore, specifications for structures included within the scope of the paper have been, to a great extent, the output of designers employed by manufacturers, and have shown the effects of the latter's bias.

If this discussion seems to be largely in the line of pointing out shortcomings in the author's specifications, it is not done in any spirit of criticism, but with a desire to see the specifications properly amplified and completed before they pass into a form which may be adopted as a standard. It is the writer's view that a technical specification should be something more than a mere check on the contractor; it should be a manual of design, complete enough to be a guide for the designer, whether he be employed by the purchaser or manufacturer, and should be so explicit and unambiguous as to permit of little discretion on the part of the designer, to the end that two independent designers working from it will produce substantially the same results.

The specifications seem to start with the assumption that the general dimensions of the structure are fixed. This should not be. For any given capacity and pressure there are certain economical ratios between height and diameter for elevated tanks, and there are other ratios for stand-pipes. Something relating to these rules of proportion should be included.

The specifications cover only stand-pipes and elevated tanks with hemispherical or flat bottoms supported on steel towers. One important form of elevated tank is ignored, that is, the tank with a semi-elliptical bottom and a small stand-pipe extending from the bottom to the ground, which serves both as a partial support for the tank and as a frost-proof inlet. This form is used largely for railroad water-station tanks, and the features which are peculiar to it should be included in this manual of design.

It is convenient to assume the weight of water at 62.5 lb. per cubic foot, because this makes convenient figures for calculation, namely, 8⅓ lb. per gallon, and 7½ gallons per cubic foot. The use of two-thirds of the exposed area for computing wind pressure on cylindrical tanks is better practice than the use of one-half, as is done in many specifications. This ratio should be extended also to conical surfaces.

Table 1 allows a tension of only 12,000 lbs. per square inch in tank plates, while a tension of 16,000 lbs. per square inch is allowed in other parts of the structure. This is in

* Discussion on Mr. Birch Noid's paper before the American Society of Civil Engineers, appearing in vol. xxxv. No. 5.

accordance with common practice, and gives good results, although there is no apparent justification for the reduced unit stress. The tank plates are just as strong as structural shapes, and the loads coming upon them are just as capable of exact calculation. Of course, the ordinary reason for using a reduced unit stress is to provide extra section to cover corrosion and other forms of deterioration. It would seem more rational to provide for this by an arbitrary addition to the thickness computed from the static pressure and net section. In fact, the writer has found it desirable and not any great hardship to specify an additional thickness of 1-16 inch for tanks designed for a unit stress of 12,000 lbs.

The allowable shear on rivets is given as 12,000 lbs., with no stipulation that there shall be any reduction of this unit stress for rivets in tank plates. If the tank plates are designed for 12,000 lbs. per square inch in tension, the rivets certainly ought to be designed for proportionately low unit stresses in shear and bearing. The allowed shear on field rivets and bolts is lower than that usually permitted. It is customary to prescribe that the number of field rivets shall be increased 25 per cent. more than the number required for shop-driven rivets. On this basis the shear in field rivets would be 9,600 lbs. per square inch instead of 9,000 lbs.

No information is given in the specifications as to the efficiency of riveted joints. This is an important feature in designing tanks and boilers, as the computations, usually are made directly on the basis of the efficiency of the joint, rather than by the more indirect process of computing the net section. It would be desirable to include a table showing the computed efficiencies of single- and double-lapped joints and single-, double-, and triple-riveted butt joints for various thicknesses of plates and diameters of rivets. Such tables are used by every manufacturer, and are published by some of them.

The use of the percentage of efficiency in the joint results in a simple formula for determining the thickness of plates in tanks subjected to hydrostatic pressure. Thus, if D = the diameter of the tank, in feet, H = the height, in feet, from the point considered to the surface of the water; the pressure, in pounds per square inch = 0.434 H. The tension in the plate for 1 inch in height = t = 2.6 D H. The required net area of the plate for 1 inch in height = A = t ÷ f, f being the unit stress, in pounds per square inch of net section. For f = 13,000 A = 2.6 D H ÷ 13,000 = 0.0002 D H. For an efficiency of two-thirds in the riveted joint, the gross area in 1 inch of height = the thickness of the plate, in inches = A ÷ ⅔ = 0.0003 D H. To this should be added the additional thickness of 1-16 inch already referred to. This formula, thickness of plate = 0.0003 D H, makes a convenient and rapid method of determining the thickness of tank plates. For a unit stress in tension of 12,000 lbs. the same formula results, if an efficiency of 72 per cent. is assumed.

It is customary to design on a basis of efficiency of at least 66 per cent., and that would rule out all single-riveted lap joints. Section 14 specifies lap joints for vertical seams in plates ⅜-inch thick and less, but does not specify whether they shall be single or double. They should be specified as double-riveted, with the possible exception of ¼-inch plates, in which the full strength of the plate is not developed. Double-riveted butt joints with the rivet diameters specified in section 15, will secure an efficiency of at least 70 per cent. up to and including a thickness of ¾-inch. For that reason it would seem desirable to design for an efficiency of 70 per cent., and specify triple-riveted butt joints for plates having a thickness of 13-16-inch or more.

The unit stress in compression should be limited to a maximum of 15,000 lbs. for short columns.

Section 10 is ambiguous in that it allows unit stresses of 20,000 lbs. in bracing, without specifying whether the unit stress referred to is for tension, compression, shear, or bearing. It gives a desirable addition to the bracing—which otherwise may be designed too light—to assume an arbitrary initial stress in all bracing members of 5,000 or 10,000 lbs.

Section 12, specifying that plates forming the sides of cylindrical tanks shall be of different diameters, is not explicit. Of course, it means that the inside diameter of one plate shall be the same as the outside diameter of the next one.

In Section 13 it is not clear just wheat is meant by radial seams in a spherical bottom.

Section 16 specifies that plates more than ⅝-inch thick shall be sub-punched and reamed, but does not specify the diameter of the punched hole and the amount to be removed by reaming.

Section 29 gives a rule for proportioning the stiffening member around the top of the tank, and specifies that the section modulus may be reduced under certain conditions, but does not specify definitely to what extent it may be reduced.

Section 35 allows an additional height of 6 inch for overrun. This is not clear. Presumably the meaning is that 6 inch in height shall be added to that required for the specified capacity in gallons.

Section 36 specifies that the bracing in towers shall be adjustable. Certainly riveted bracing for towers is better practice, although adjustable bracing may be allowable, on the score of economy, and the riveted bracing should not be excluded.

Section 37 specifies unit stresses in the anchor-bolts not exceeding 15,000 lbs. per square inch. Presumably, this refers to unit tensile strength, but it is not explicit. There is no specification covering the excess of the area at the root of the thread, and no specification which would produce good details in the design of the anchorage connections. Too many anchor-bolts are connected simply through the base plate of the column without provision for developing properly the full strength of the bolt, and this should be covered by a specification which will insure a good detail.

Section 38 specifies concrete sufficient in quantity to take the uplift, but does not provide any factor of safety. It is good practice to provide at least 1½ or two times the computed uplift in the weight of the concrete. Furthermore, the specification should include a provision that the arrangement of the anchorage in the concrete shall be such as to develop the full weight without depending on the tenacity of the concrete to hold the mass together; otherwise, this provision is apt to be overlooked, thus resulting in bad practice.

Sections 40 and 41 specify that the quality of materials and workmanship shall be according to certain specifications referred to by name. It would add little to the bulk of these specifications and much to their completeness if the specification for quality of materials and workmanship were written out in full.

(Continued on Page 22.)

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7279—June 1—Authorizing the Essex Terminal Railway Co. to take additional lands for the purpose of alterating its line at the Windsor Fair Ground and Driving Association, Windsor, Ont.

7280—June 18—Ordering the C.P.R. early in the spring of each and every year, and before the water commences to run, to clear away any ice and snow that may have formed during the winter months underneath the bridge over Buffalo Lake on the north-east quarter of Section 32, Township 2, Range L, west first principal meridian, Manitoba.

7281—June 18—Directing the Canada Atlantic Railway (G.T.R.) to provide a suitable crossing where the company's railway abuts the land of Thos. Wilson, in the County of Carleton, Ont., near Ottawa, Ont.

7282—June 18—Approving by-law of the Salisbury and Harvey Railway, authorizing A. Sherwood, general manager for receiver, to prepare and issue tariffs of tolls to be charged for all or any tariffs carried by that company.

(Continued on Page 17.)

# THE LAYING OUT OF THE TRACK IN THE MUSKOKA DIVISIONAL YARD.

C. D. Norton.

For many years the Canadian Pacific Railway did not have direct connection between Toronto and the district Toronto represented and Western Canada. It is true they had a traffic agreement with the Grand Trunk Railway by which they used the Northern Division of the Grand Trunk

Muskoka Yards, Looking North.

to North Bay, but in 1902 the C.P.R. decided to build a line connecting Toronto directly with the West, which, when built, became known as the Toronto-Sudbury branch of the C.P.R.

This article deals with the laying out of Muskoka, the only division point on the line.

Nothing new or of any scientific importance will be found in the following article, but it may be helpful to those who have not had much experience with trackwork, especially if they are required to produce results in a hurry.

is in practical work all settled beforehand, and governed by standard rules. It need only be taken into consideration in special cases, as when one switch follows too closely upon another or when a turnout is on a curve. When once a starting-point is established it will be found better to ignore centres and use the gauge line of the rail, and set all stakes to it, which will bring results ready for the foreman.

When possible it is advisable to reference points so that

Ash Pit, Oil House and Round House, Muskoka.

if necessary they can be picked up with a tape, either by the engineer or the foreman. The latter should be watched, though; the average is far from accurate.

In the yard under consideration a large part of the subgrade was built by train-fill, and the above method was found very useful, every second or third frog being, of course, checked with a transit.

Before any frogs are set it is advisable to check the angles, as sometimes a No. 7 proves to have a 6¾ or 7¼ spread, and any found to be wrong should be put in where

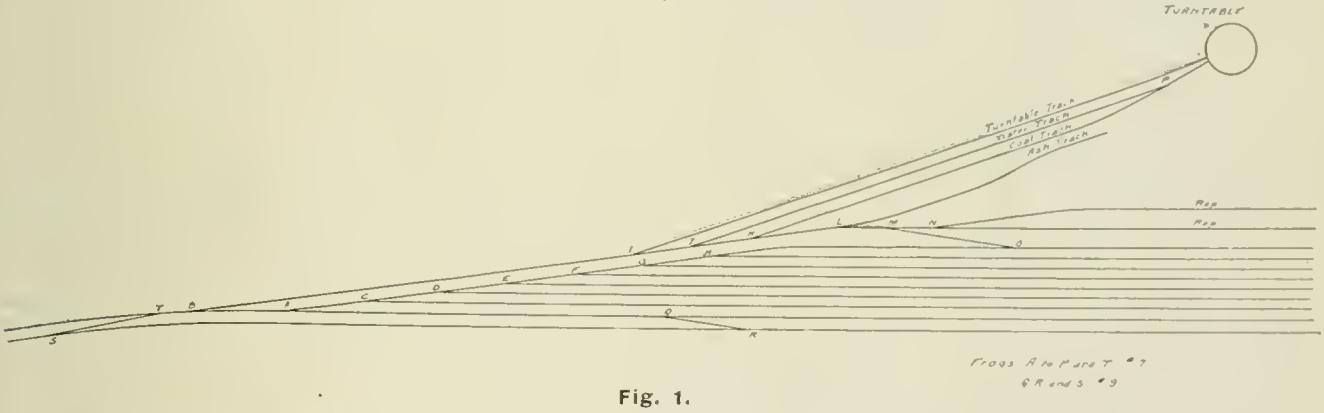



Fig. 1.

The writer was provided with a plan of the proposed yard, shown in sketch (Fig. 1); this was drawn to a scale of 50 feet to an inch, and it gave only the distances between tracks, and the chainage of the P.I. of the ladder track and the through siding. Quite contrary to the usual procedure of railway construction, the plan arrived some time before the work was required to be laid out, thus allowing ample time for experiment; but it would be only fair to mention that the time-honored custom was not forgotten, and, at a later date, the location of one of the tracks was altered, necessitating the relocation of the adjoining switches.

The layout of a series of switches seems very simple on paper, but the stakes on the ground are puzzling enough to the man who set them there, and to the foreman they are meaningless until he is shown exactly how the switches are to run. Care should be taken to leave in only such stakes as the foreman can conveniently work from; practically all that he needs is a stake set at the actual point of frog and an occasional centre. If too many are put in he will most certainly mistake them and evolve some very peculiar and expensive results. All details regarding the lining of the lead-out curve and other minor details are best left to the foreman, as that is his business. The length of the lead, although dealt with very thoroughly in text books, it will not be in conjunction with another frog. They should never be used on ladder tracks, but can sometimes be put in a cross-over if due allowance is made.

After a careful perusal of the plan, a thorough search was made through the available text and note books, and it was found that these gave only the theory, with little or nothing of practical work, especially regarding split switches. Those books published for the guidance of trackmen were certainly more useful, but, of course, instrument work is not touched upon in them.

The following are the principal problems involved and their respective solutions:—

The P.I. of the ladder track and the through siding was established according to the chainage, and the point of frog was found as shown by the following sketch:—

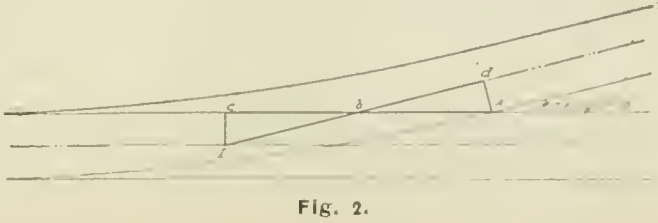


Fig. 2.

The two triangles I c b and A b d are similar, and it is necessary to find c b and b A, the perpendicular and the hypotenuse, respectively, the base c I or d A and the angles c b I and d b A being known.

$$c\,b = \tan \frac{c\,I}{c\,b\,I} \qquad b\,A = \sin \frac{d\,A}{d\,b\,A}$$

$\frac{g}{2}$ = 2.354 ..... log 10.371806

c b I = 8° 10′ 16″ .....log tan 9.157116

c b = 16.394 ..... log 1.214690

$\frac{g}{2}$ = 2.354 ..... log 10.371806

d b A = 8° 10′ 16″ .....log sin 9,152685

b A = 16.563 ..... log 1.219121

16.394 + 16.563 = 32.957 = c A.

To this distance must be added the difference between the actual and the theoretical point of the frog. Frogs are usually ½-inch thick at the point, which would make this distance in a No. 7 to be 3½ inches, or .292 of a foot.

32.957 + .292 — 33.249, or 33.25.

This distance was set off on the centre line and the rail marked at right angles for the first frog on the ladder track, numbered A. The next frog to be set was that for the engine track, No. B, which was parallel to and 15 feet distant from the ladder track.

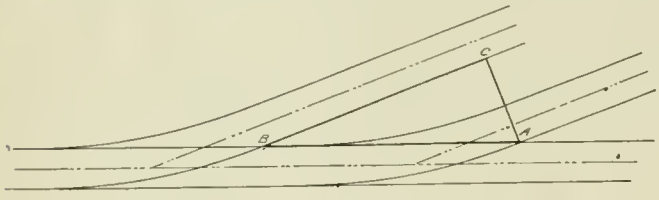


Fig. 3.

In the triangle A B c, A is the frog of the ladder track and B that of the engine track, c A being the distance between the tracks and A B the distance required.

$$A\,B = \frac{A\,c}{\sin c\,B\,A}$$

A c = 15′ ..... log 11.176091

c B A = 8° 10′ 16″ .....log sin 9.152685

A B = 105.54 ..... 2.023406

Which distance was laid off and a stake placed at B.

The next proceeding was to lay out the frogs on the ladder track, lettered C to H. The first method was to set up the transit over the point of frog A, deflect the angle, and lay off the various distances. This was found to be rather unpracticable, owing to the difficulty in measuring with a chain over piles of ties, rails, and other material,

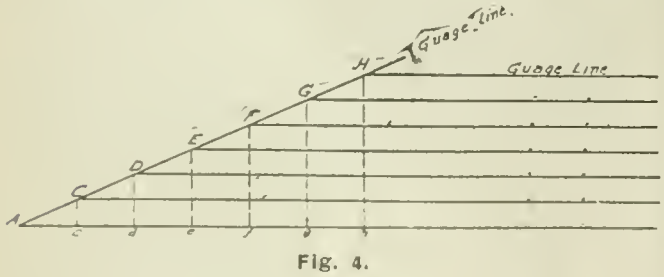



Fig. 4.

which also partially obstructed the line of sight. The corresponding distances were, therefore, laid out on the through siding and offsets taken out to the ladder track as in sketch No. 4.

The frog angle C A c, C c, D d, E e, the distances from the respective sidings being given—

$$A\,C = \frac{C\,c}{\sin C\,A\,c} \qquad A\,c = \frac{C\,c}{\tan C\,A\,c}$$

The similar triangles D A d, E A c, etc., being likewise solved, each one separately to avoid cumulative errors. Points were thus easily found with a fifty-foot tape.

The following table gives the distances as laid out:—

| No. of frog. | Cs. | Distance from through siding. | Distance along through siding. | Distance along ladder track. |
|---|---|---|---|---|
| C ..... | 14 | 14 | 97.5 | 98.5 |
| D ..... | 13 | 27 | 188.0 | 189.9 |
| E ..... | 13 | 40 | 278.6 | 281.4 |
| F ..... | 13 | 53 | 369.1 | 372.9 |
| G ..... | 13 | 66 | 459.6 | 464.4 |
| H ..... | 13 | 79 | 550.2 | 555.8 |

The south ladder track was staked out in similar fashion.

Opposite the end of the ladder track the turntable track turned off to the roundhouse, making an angle of 9° 31′ with the engine track, and at the heel of the frog (I) about 25 feet of 3° curve is shown on the plan. This was rather a puzzler, but was solved in the following manner:—

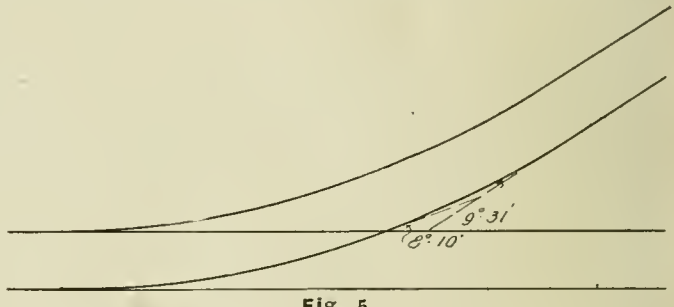



Fig. 5.

In this figure is shown the engine track and the angle of 9° 31′ turning towards the turntable. It is obvious that if the frog be moved back that the line of the frog will intersect the line of the track, and the intersecting angle will be the difference between the frog-angle and the total angle between the two tracks.

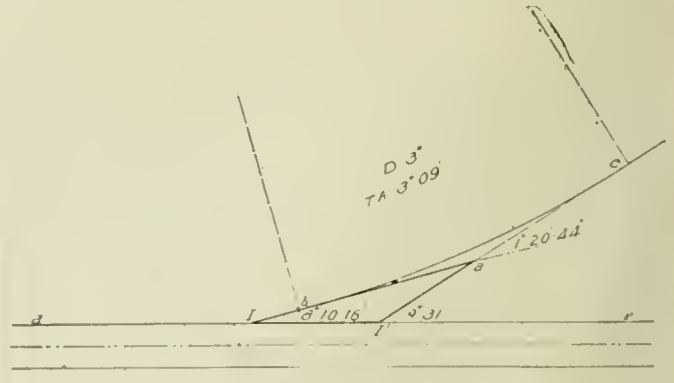



Fig. 6.

In the above figure d e is the line of rail of the engine track, c I′ that of the turntable track, the point of intersection I′ being found on the ground, which angle a I′ d is 9° 31′. Let I be the position of the frog; then the angle I a I′ = 1° 20′ 44″.

We find from the tables that the sub-tangent for a 3° curve with a central angle of 1° 20′ 44″ is 22.43 feet. To this distance add the length of the frog from point to heel, which in the present instance was 7.25 + .29, the difference between actual and theoretical points, which total is 29.97.

In the triangle I a I', being given the side a I and the angles a I I' and I a I', it is required to find the side I I'.

$$I\,I' = \frac{I\,a \sin I\,a\,I'}{\sin I\,I'\,a}$$

I a = 29.97 ..... log 1.476687
I a I' = 1° 20' 44" ..... log sin 8.370740

9.847427
I I' a = 170° 29' ..... log sin 9.218303

I I' = 4.256 ..... log .629064

On the gauge of the engine track this distance was laid off **back** from the intersection point, giving the point of frog one for the turntable track.

The frog points for the water and coal tracks, numbered respectively J and K, were staked according to the table, the hypoteneuse distance being used. Then came about the alteration in plan which has been mentioned. The distance between the turntable and water tracks, originally 14 feet, was changed to 15 feet. This would require that the distance between frog points J and K should be 105.6 instead of 98.5, and the point K moved ahead 7.1 feet. This could not be done, owing to the fixed position of Frog L leading on to the repair track, which point was found by intersecting the gauge-lines of the engine and repair tracks. By allowing the shortest possible distance between heel of frog and point of switch the frogs J and K were both moved back towards I, so that only a surplus of 0.5 feet was left. This was eliminated by shortening the lead of Switch L.

Point of Frog M was next set by allowing the switch to lead off at a convenient distance from the heel of Frog L, and Frog N staked similarly.

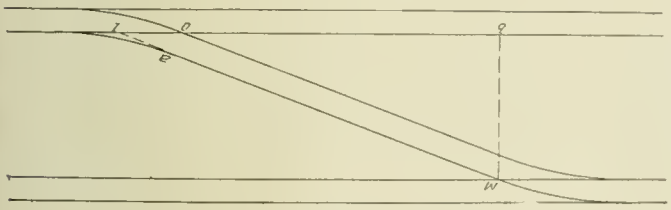


Fig. 7.

The cross-over from Frog M to Frog O was laid out as follows: The transit being set on Frog M, the angle 8° 10' was deflected and an intersection made with the gauge of siding No. 8 at I'.

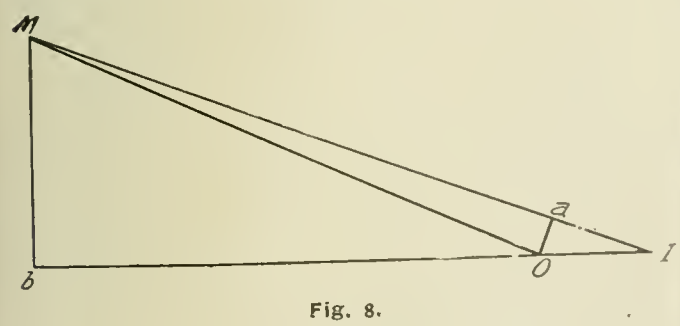



Fig. 8.

In the triangle a O I given a O and the angle a I O it is required to find O I.

$$O\,I = \frac{a\,o}{\sin a\,I\,O}$$

a O = 4.708 ..... log 10.672836
a I O = 8° 10' 16" ..... log sin 9.152685
O I = 33.13 ..... log 1.520151

This distance (3,373 feet) was measured back from I on the gauge line setting the point of Frog O. The method of measuring b O as given in text books is only applicable when the parallel tracks are already in and level to centre. If no instrument is available, the point can be accurately set by measuring the three sides of the triangle M b, M O and b O.

In the triangle M I b the perpendicular M b and the angle M I b are given it is required to find the side b I.

$$b\,I = \frac{M\,6}{\tan M\,I\,6}$$

b I = 20' 4.70" = 21 ; ..... log 11.328380
M I b = 80° 10' ..... log tan 9.157116
b I = 148.34 ..... log 2.171264
b O = b t — O, = 148.34 — 33.13 = 115.21.

In the triangle M O b—

$$M\,O = \sqrt{M\,6^2 + 6\,O^2}$$
$$= \sqrt{(21.3)^2 + (115.21)^2} = 117.16$$

For Frog P the transit was set over the centre of the pit and the frog angle deflected from the centre line of the turntable track; then the gauge line was offseted and an intersection made with the gauge of the water track, the distance being checked as per table.

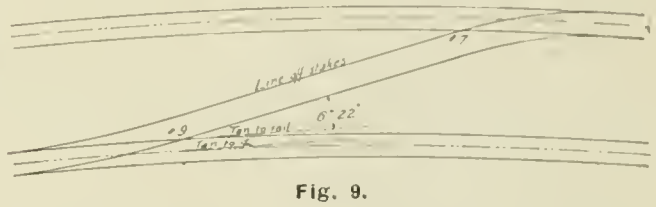



Fig. 9.

The cross-over on the south side of the station was staked out as on repair track, but the one on the north end was rather complicated. These cross-overs were not shown on the original plan, and Frog H came on the easement curve, so, to simplify the laying out, it was considered as being on tangent, necessitating about a hundred feet of 2° curve to connect with the central curve of 3°. Afterwards this proved rather awkward, as it brought the siding frog on a 2° curve, with 16½-foot centres and the main line frog on a 3° curve with 15-foot centres.

There appeared to be no simple mathematical solution, so careful platting was tried. This was not quite a success, owing to the difficulty of working with such small angles and flat curves, as, on a scale of 10 feet per inch, a 2° curve is practically a straight line. Recourse was then made to a method of trial and error in the field. Centre stakes were set on each of the two curves, 10 feet apart, and at the probable position of frogs the gauge of rail was laid out every two feet by ordinates offset from the 10-foot chords, and the Frog S set at a safe distance from the switch points on the siding. A tangent to the 3° curve at the centre opposite the point of frog was run and a parallel line offset through the same point, from which the frong angle 6° 22' was deflected, as shown in Fig. 9, and stakes set to sight by.

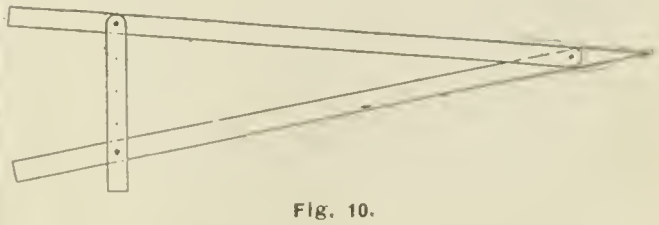


Fig. 10.

A frog-board, adjustable to a spread of 1'.7 and 1'.9 was moved too and fro on the gauge of the siding. The spread of 1'.7 fitted best at a certain point, and a stake was set for a No. 7 frog, and carefully referenced. The distance

between frogs has unfortunately been mislaid, but, being on a particular layout, is of no general importance.

The frog-board used at the time was a rough affair of three pieces of siding and three nails, knocked together with an axe. An adjustable one is shown in Fig. 8, the holes on the base being bored for the different angles. This will be found very useful in laying out frogs in difficult places, especially in conjunction with switches already in.

Although in the foregoing calculations the decimals run into two and three figures, this was done to avoid cumulative errors, and were by no means used on the ground, the nearest ½-tenth being accurate enough. If the track has to be laid on rough rock grade, as happened in this case, the engineer is lucky if he can get the resultant frogs and switches within a couple of tenths, and in case of doubt it is better to have the foreman err on the side of having the point of frog moved towards the toe instead of vice-versa.

## THE RELATION OF THE CHARACTER OF COALS TO THE PREVENTION OF SMOKE.

By D. T. Randall.†

The semi-bituminous and bituminous coals are the most extensively used of all the fuels which are available for generating steam. Containing as they do a considerable quantity of volatile matter which is given off when the coals are heated in the furnace, it is difficult to burn them under boilers so as to secure perfect combustion and freedom from smoke. Specially designed furnaces and careful operation are required to get good results.

The difference in the character of coals is only partly shown by the proximate analyses which are commonly used, but to one familiar with coals these analyses indicate in a general way the leading characteristics of the coals.

To show the difference in fuels the following table has been prepared:—

**Table I.—Analyses of Fuels as Delivered and Used.**

| | Coke | Anthracite pea coal | Pocahontas coal | Pittsburg coal | Indiana coal |
|---|---|---|---|---|---|
| Moisture | 4.67 | 4.75 | 1.12 | 2.48 | 9.62 |
| Volatile matter | 2.82 | 2.90 | 17.24 | 38.74 | 36.14 |
| Fixed carbon | 82.61 | 77.15 | 74.84 | 49.18 | 41.22 |
| Ash | 9.90 | 15.20 | 6.80 | 9.60 | 13.02 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Sulphur | ..... | 0.80 | 0.71 | 1.85 | 4.43 |
| B.t.u. | 12206 | 11886 | 14530 | 13172 | 11122 |

It will be noted that coals vary both in their composition and in their heating values (B.t.u.) and in consequence they are more or less valuable as fuel, depending on these variations.

Other things being equal, a fuel high in fixed carbon is more easily burned in a common furnace without loss of heat and without smoke than those of lower percentages. Coke and anthracite coals are examples of this class of fuels.

The percentage of moisture is not of great importance except in cases in which the coal is naturally high in moisture, or in which the coal is very wet as a result of washing or exposure to storms. Moisture in small percentages seems to aid combustion, but in larger amounts it retards the ignition of the gases and lowers the furnace temperature. It may or may not increase the smoke, depending on the character of the fuel.

The percentage of ash and especially the character of the ash is of importance in connection with the smoke problem. Ash which is fusible and runs down on to the grate bars may cause smoke by shutting off the flow of air through the fuel, and by increasing the poking which is necessary to keep the grates free. Coals which clinker badly require more attention from the firemen and poking the fire is a common cause of smoke.

There is a great difference in the behaviour of the same coals when burned under different furnace conditions, and in different furnaces. Some grates and stokers are adapted to handle coals which are burned with great difficulty on other equipment.

The rate of burning per square foot of grate is often the deciding factor as to whether a given coal may be used or not. This is principally due to the higher temperatures which are obtained with high rates of combustion, and its effect on the fusible portion of the ash of the coal. Investigations are now being made to determine the characteristics of the ash of representative coals as related to the clinker formed at various temperatures.

So far as smoke is concerned the volatile matter is of the greatest importance. The quantity of volatile matter is not a true measure of the difficulty of burning a coal, but to one familiar with the various coal fields it is of great assistance in choosing a suitable coal or in designing a furnace suited to the given coal.

Investigations relating to the nature of volatile matter in representative coal have been carried on at the Government Fuel Testing Plant, at the University of Ohio and at the University of Illinois.

The results show that the differences in the gases given off from coals may be due to the composition of the coal and to the temperatures to which the coal is subjected when placed in the furnace. The higher temperatures tend to distill the volatile matter more rapidly and drive off the heavy hydrocarbon in forms which are difficult to burn without smoke.

**Table II.—Absolute Quantities of Smoking Products in Ten Minutes Heating at Different Temperatures.***

* See paper by Porter & Ovitz in Journal of American Chemical Society, vol. xxx.

| | Temperature Degrees C | | Smoking Products | |
|---|---|---|---|---|
| Coal | Furnace | Coal | Tar per cent. | $C_6H_6$ - c.c. |
| 3 Connellsville | 600 | 441 | 4.9 | 61 |
| 1 Ziegler, Ill. | 600 | 440 | 6.8 | 51 |
| 3 Connellsville | 700 | 562 | 11.0 | 145 |
| 1 Ziegler | 700 | 545 | 7.8 | 24 |
| 16 Pocahontas | 700 | 599 | 4.2 | 138 |

The above table gives some idea of the complicated relation between the temperature of the coals in the furnace and the compositions of the various gases to be burned. Investigations of this character are necessary to determine the characteristics of coals from each of the representative beds.

The combustion of coke or other fuels high in fixed carbon is comparatively simple. The greater portion of the fuel is burned on the grate; the remainder in the form of gas burns at a short distance above the bed of fuel. This may readily be observed on a fire of anthracite coal in which there is only a small percentage of volatile matter.

In burning bituminous coals, however, the difficulties are much greater and for the reasons given above. The volatile matter from some coals is set free more readily than from others, and with some coals the nature of the volatile

* Presented at the Syracuse meeting of the International Association for the prevention of smoke, June 24-26, 1909.

† Engineer in charge of Fuel Engineering Department, Arthur D. Little, Inc. Laboratory of Engineering Chemistry, Boston, Mass.

matter given off is such as to make it very difficult to secure complete combustion. Smoke is an indication of incomplete combustion and the problem of reducing the amount of smoke is important, not only from the standpoint of the smoke inspector, but also because of the losses in combustible gases such as carbon monoxide (CO) and hydrogen which escape with the smoke.

**Table III.—Showing Relation of Smoke to CO in Flue Cases.***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Average per cent. of black smoke | 0 | 7.1 | 15.5 | 24.7 | 34.7 | 43.1 | 52.0 |
| Average per cent CO in flue gases | 0.05 | 0.11 | 0.11 | 0.14 | 0.21 | 0.33 | 0.35 |
| Number of Tests averaged ..... | 37 | 18 | 56 | 51 | 36 | 17 | 4 |

Experiments by several investigators have shown that whenever smoke is given off there is also a considerable quantity of carbon monoxide gas, and that as a rule this gas is accompanied by small percentages of hydrogen and hydrocarbon compounds. The losses due to these combustible gases which are found in connection with a smoke stack may vary between one and ten per cent. of the fuel.

**Table IV.—Showing Relation Between CO in Flue Cases and Other Combustible Cases.†**

| | Smoky | | | | Clear. | | | |
|---|---|---|---|---|---|---|---|---|
| Boiler Furnace | $CO_2$ | CO | $CH_4$ | $H_2$ | $CO_2$ | CO | $CH_4$ | $H_2$ |
| Hand Fired . | 10.95 | 3.00 | 0.70 | 3.23 | 8.15 | 0.0 | 0.0 | 0.0 |

When burning a bituminous coal, the volatile matter must be raised to a high temperature while mixed with a sufficient quantity of air and burned on its passage from the fuel bed to the surfaces of the boiler. In most boiler settings this distance for combustion is very short and when the gases strike the cold surfaces of the boiler shell or tubes they cool below the temperature at which they will burn rapidly, and as a result some escape unburned and others are only partially burned, as shown by the heavy deposits of soot. In properly designed furnaces the space provided for combustion is large for coals giving off high percentages of volatile combustible. Even in such furnaces the firing must be carefully done or at times enough air cannot be supplied to the gas, and smoke results for short periods. In most plants the time required for the gases to pass from the fuel bed to the top of the stack is between 10 and 15 seconds, assuming the velocity to be reasonably uniform at different sections, then it will be seen that the gases pass from the fuel bed to a distance of say 12 feet in one second. At the end of this period there is but little opportunity for the gases to burn. This will make clear the great importance of a sufficient air supply, properly distributed, and an ample space above or back of the grates in which the gases may thoroughly mix and burn within considerably less than one second of time.

That there is a loss due to the volatile gases escaping unburned from an ordinary furnace is shown very clearly by the results of tests made on house heating boilers. The following table gives figures obtained on two series of tests for the purpose of determining the fuel values of several coals and briquettes,* when burned in a house heating boiler.

**Table V.—The Relation of Volatile Matter of Smoke and Unconsumed Cases.**

| Number of tests | Volatile matter in the com- | Ash in dry | Black | CO in dry | Averaged bustible | Coal | Efficiency | Smoke | Flue Gases |
|---|---|---|---|---|---|---|---|---|---|
| 4 | 18.30 | 8.00 | 60.56 | 18.2 | 0.44 | | | | |
| 12 | 22.71 | 8.04 | 56.33 | 18.0 | 0.50 | | | | |
| 7 | 34.70 | 11.27 | 54.11 | 22.1 | 0.55 | | | | |
| 11 | 38.70 | 15.02 | 47.19 | 37.8 | 0.62 | | | | |
| 10 | 44.46 | 14.57 | 47.19 | 32.9 | 0.74 | | | | |

The furnace in which the results shown in Table V. were obtained is best suited to coke, anthracite, or low volatile coals, and, as will be seen, is not adapted for burning bituminous coals, with good efficiency, yet many furnaces having practically the same features, such as a grate surrounded by heating surface, and a small combustible chamber, are used in power plants for burning high volatile coals.

Even with furnaces of improved design it is difficult to charge the coal by hand firing and secure smokeless combustion. This is due to the fact that a comparatively large quantity of gas is liberated immediately after firing, at the same time the fuel bed has been thickened and the air enters with more difficulty and without being well distributed with respect to the gases rising from the bed. With such a furnace the loss of combustible gases may be reduced to 5 per cent. or less depending on the coal and the operation.

It is because of the advantage in having the coal gradually heated and the gases distilled from it at a low temperature that a mechanical means of feeding the coal to the furnace is usually more successful in the prevention of smoke.

A good furnace should permit the burning of bituminous coal in sufficient quantities without loss of escaping gases or the formation of smoke when the air supply is about 50 per cent. in excess of the theoretical amount.

It has been found by experience that to approach this performance, the coal must be fed regularly in small quantities, gradually heated if possible, and the air supply admitted in such a way as to thoroughly mix with the distilled gases. Furthermore the space for burning the gases should be large and preferably enclosed in fire bricks.

A furnace suitable for certain coals may be entirely unsuited to other coals and it is only after a careful study of all the factors, such as power to be generated, size and kind of boiler to be used, and the coals available, that an engineer can undertake to design a furnace which will be satisfactory and at the same time give good economy under operating conditions.

Even after the best types of furnaces are installed it is necessary to supervise the operation of the boiler plant closely in order to secure the best results. The proper drafts, the best thickness of fire for any given coal when burned on grates at the rate required for the plant, and the best method for the removal of ash and clinkers to prevent loss of fuel into the ash pit are all factors in securing the highest economy. Failure to attend to these important details may easily cause a loss of as much as 10 per cent. in the fuel fed to the furnaces.

In conclusion:

1. Even well designed furnaces may be expected to give off smoke if improperly operated, or under any of the following conditions:
   - (a) When a new fire is built in a cold furnace.
   - (b) When an excessive amount of coal is burned on the grate, making it difficult or impossible to properly mix the air with the gases and burn them in the furnace
   - (c) When the rate of combustion is suddenly changed, due to a change in demand for steam, for the same reasons as under (b).
2. Smoke may be reduced and in most cases prevented:
   - (d) By burning a fuel having a small amount of volatile matter.
   - (e) By burning a bituminous coal in a specially designed furnace with more than ordinary care on the part of the fireman under the supervision of a competent engineer.

* See United States Geological Survey Bulletin 325, pages 101 and 167.

† See Manchester (England) Smoke Abatement Report.

* See United States Geological Survey Bulletin No. 366.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## VOLUNTARY ADVICE AND WINNIPEG'S SEWERAGE.

It has been said that one volunteer is worth three pressed men. That this is true, when expert advice is required, we are inclined to doubt. However, the city of Winnipeg is blessed with an association of gentlemen termed "sanitary" who think they can tell the corporation something worth knowing about the city's sewerage system. Probably they can. On the other hand, it appears doubtful that they can supply any information which the city council could not obtain from their paid officials.

A delegation from this association waited upon the Board of Works, with the simple request that they be allowed to inspect the main sewerage system, as it was suspected that a fair amount of filth was resting peacefully in the sewers, instead of moving forward.

It appears to suggest itself, that instead of wasting the time of an important body, such as the Winnipeg Sanitary Association on such a quest, it would have been easier to have got this information by at once despatching one of the officials of the sewerage department, who might have returned there and then with the necessary data.

This Sanitary Association appears to include several ex-aldermen. Herein consisteth the leven of busybodyism. An alderman never appears to take any practical interest in civic affairs until he obtains the ancient order of Ex. Out of the council he waxes wroth, and feels that civic legislation spells ruin without the benefit of his advice.

We take that this Sanitary Association is a sort of scientific ratepayers' association, composed of the men who would like to be, but are not.

This Sanitary Association may, however, be of value in bringing pressure upon the powers that be, and making the blind see. They may remind the present aldermen that the title of Ex is awaiting them also if they do not make a move.

From all accounts it appears certain that the city of Winnipeg has outgrown its present sewerage system. Five years ago an expert was called in to give an opinion on the then condition. To-day, Winnipeg is an entirely different propostion from what it was five years ago.

Winnipeg corporation will adopt a sound policy in having a thorough survey and inspection of its present sewerage system, together with a report as to improvements necessary to meet present and future requirements and prevent further pollution of the river from the present untreated foul discharges.

## SEWAGE DISPOSAL AND DISINFECTION.*

Sir James Crichton-Browne, M.D., LL.D., F.R.S., in his address the other day to the International Congress of Applied Chemistry (Section of Hygiene), has some interesting remarks to make on the biological system of sewage disposal as follows:—

Are we at present engaged in perpetrating another failure at a still more exorbitant cash outlay? I think not, for the bacteriological system is not an empirical or isolated or haphazard experiment, but an evolutionary growth and an imitation of Nature, which never fails. It is a reversal of most previous systems in that it seeks not to arrest but to promote decomposition. Originating in the discovery of the illustrious Pasteur in 1862 that putrefaction is the work of micro-organisms, and advanced by the observations of Schlosing and Muntz in 1877 that nitrification is accomplished by the agency of bacteria, it did not take practical shape until the experiments of the Board of Health of Massachusetts were instituted in 1888. Thereafter it owed its development to Scott Moncrieff, who in 1892 introduced his cultivation tanks and nitrification channels, and subsequently attempted to secure greater aëration of the effluent by various devices Following him came Dibdin with his downward filtration through coarse filter-beds, and later with his contact beds, and Mr. Donald Cameron, of Exeter, with his septic tank, which still, with many additions and modifications, holds the field.

The bacteriological system has by no means reached its final stage. It is being improved daily, and we may look for an increase of its efficiency to the constant observations of a number of highly scientific and able Medical Officers of Health, to the analyses of our chemists in their laboratories, and to the recommendations of the Royal Commission on Sewage Disposal which has been sitting in this country since 1898, and which still continues its deliberations. But while many refinements in the bacteriological system may be expected and many adjustments of it to varying local requirements and the particular quality of the sewage to be dealt with as affected by trade refuse and in other ways, the fundemental principles underlying it are, it seems, established. It is now certain that the sewage of a great city, amounting, perhaps, to thousands of tons and loaded with animal and vegetable waste products, can be effectually and inoffensively disposed of by anaërobic and aërobic bacteria and reduced to their original inorganic elements. Our dependence, it is said, must henceforth be placed in a tank and a heap of cinders.

The theory and practice of sewage treatment by bacterial methods is fully set forth in the text books on the subject. I am not acquainted with those of the Continent, but I can say that in this country we have fortunately admirable and lucid expositions in the works of Dr. Rideal, Dr. Barwise, and Mr. Martin, while the United States can boast of an inimitable summary in the Reports of the Massachusetts Institute of Technology. It would be disrespectful to your knowledge and intelligence were I to attempt a résumé of what they set forth, while as for what may be called the moot points in the system, the new developments, the recent mechanical improvements. these will be brought before us in the several papers to which we are to be privileged to listen. We shall, I have no doubt, hear something of the dangers of spraying septic sewage, and so wafting pathogenic streptococci abroad; of the determination of the rate of oxygen absorption by sewage of different qualities, of the different standards of sewage effluents; of the relative advantages of different kinds of sprinklers and distributors, and of coarse and fine grain, and deep and shallow filter-beds, of the use of methylene blue in testing sewage effluents; of the hydrolysis advisable for sewages of various strengths, and of the danger pointed out by our vice-presi-

* Presidential address delivered at the International Congress of Applied Chemistry (Section of Hygiene), May 28th, 1909.

dent, Dr. Kenwood, of sewage becoming over-septicized if left too long in a septic tank, resulting in a deposition of colloid matters which interferes with the working of the tank.

On none of these topics must I touch, but there is just one question raised by Dr. Barwise, who brings ingenuity, insight, and exact methods to the study of all sewage problems, to which I should like to allude. He has recently contended that bacterial beds are not correctly so called. They are, in his view, entomological menageries stocked not only with bacteria, but with many varieties of animal life. He does not attempt to classify the animal inhabitants found in biological filters, but believes that in small grain filters, at any rate, the destruction of organic matter is mainly effected by small river worms. As there are about one thousand species of these he does not identify the principal operators, but has recognized the Naididæ and Tubificidæ in enormous numbers, and has satisfied himself that they are extremely prolific and very gregarious. Then there are innumerable Polychata, beautiful objects under the microscope, swimming about in every specimen of the effluent. In the coarse grain filters, on the other hand, there are large worms, leeches, and countless numbers of larvæ, of gnats and flies. The suspended matter in the effluent from these coarse grain filters consists almost entirely of the casts and eggs of worms and of the larvæ of flies. The effluent from the fine filters, besides minute river worms, contains the ordinary water crustacea, such as cyclops and cyprides and fresh water shrimps. There are, too, on the surface of the water hosts of water spiders, and lately Dr. Barwise has noticed centipedes, and on some beds a small, black, jumping insect like a flea, known as the Podura, which is present in such quantities that they can be wheeled away in barrow-loads. Dr. Barwise cannot understand why these comparatively large organisms present in such quantities should have escaped attention, while bacteria which only the microscope reveals have been the subject of concentrated study.

Dr. Barwise's observations and speculations are exceedingly interesting, and open up many and far-reaching vistas of research in connection with sewage disposal. Our filter beds, it appears, are not merely rendezvous for bacteria, aërobic and anaërobic, but an olla podrida of insects, spiders, crustacæns, leeches, worms, and protozoa, all contributing something to the final composition of the broth. We must ask our zoologists to inform us of the life history of each of these, of their food habits and digestic processes, and of their internecine wars, and we must invite our chemists to investigate the changes due to their presence, occurring during the process of biolysis, and the part they play, if any, in the purification of sewage.

In the meantime I think it would be well to continue to put our faith in bacteria, and to trust to their putrefactive and oxidizing power for the breaking down of organic substances in sewage into simpler molecular forms.

## A NEW METHOD OF TREATING SEWAGE.

**By K. Imhoff, Engineer of the "Emschergenossenschaft," in Essen, Germany.**

(Continued from last week.)

The size of the subsidence tank or basin is solely dependent on the quantity of sewage to be dealt with and the period required for subsidence. No special allowance need be made for possible accumulation since the working need never be interrupted. Neither is it in most cases necessary to make allowance for increase in the bulk of the sewage by rain water: the tanks can deal with sewage diluted by rain to from three to five times its normal bulk, the period required for purification being proportionally reduced. The subsidence and septic tanks are collectively no larger than ordinary subsidence plant. Moreover, inasmuch as the circular tanks can have very thin walls, the cost of construction is in most cases less than that of ordinary subsidence plant. The attention required is practically limited to the removal of the sludge drawn from the tanks. The working expenses are accordingly small, in the absence of all complicated apparatus

### The Tanks In Conjunction with Bacteria Beds.

Where the water freed from sludge is sufficiently dilute, and can be discharged into a well-regulated watercourse, no further purification is necessary. Otherwise, bacteria beds are provided. In such cases the tanks are used for preliminary purification. The tanks are specially suitable for this purpose, for the reason that the water is not contaminated.

Opinions on this point still differ, however. Nevertheless, the view that it is preferable to supply fresh water to a bacteria bed, as to a river, appears to be gaining the upper hand. The beds are in that case capable of more work, that is to say, they can be of smaller dimensions for given requirements. But apart from this, an important advantage derived from keeping the water fresh lies in the fact that fresh water spread on bacteria beds evolves much less odour than water containing sulphuretted hydrogen.

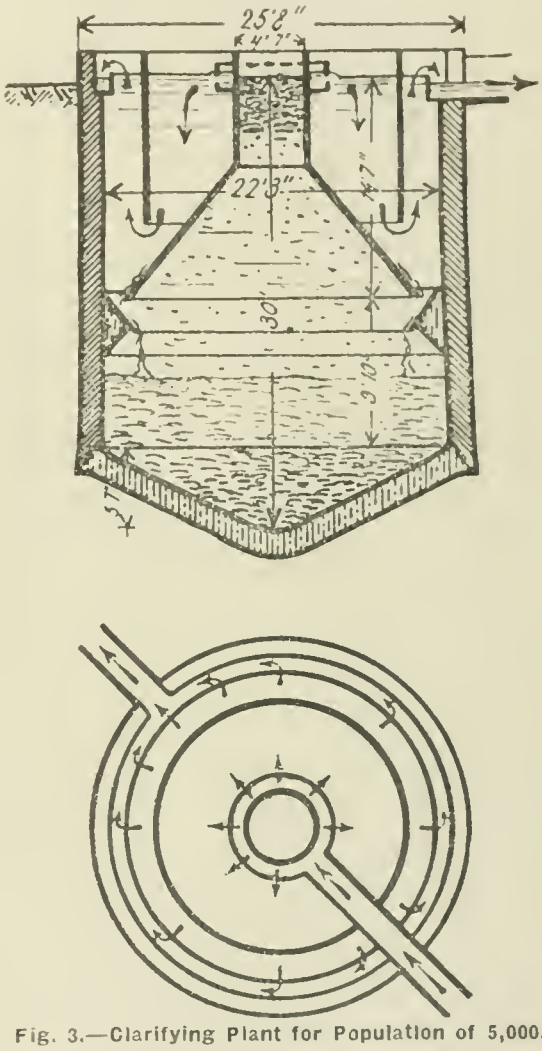



Fig. 3.—Clarifying Plant for Population of 5,000.

In England, too, there is an increasing tendency to avoid the use of ordinary septic tanks for preliminary purification on account of the odours arising therefrom. The known disadvantages of ordinary subsidence works are often preferred. A case in point seems to be that of Machynlleth, dealt with in No. 875 of The Surveyor.

It is in cases of this kind that the new system will prove of great advantage, the water being kept fresh and odourless, as in the subsidence treatment, and the sludge being dealt with as satisfactorily as in any septic tank.

In the case of percolating beds, it is usual to subject the discharge from the beds to a process of mechanical purification, in view of the large amount of sludge carried from the beds. The sludge separated by this purifying process is also capable of decomposition and has the same properties as the sludge separted by the preliminary purification. Emscher tanks can be used also for the treatment of the discharge from the beds, but in this case the subsidence tank must be de-

signed for only one hour of deposition, the sludge tank being usually about one-quarter of the size required for preliminary purification. The proportions vary, however, greatly.

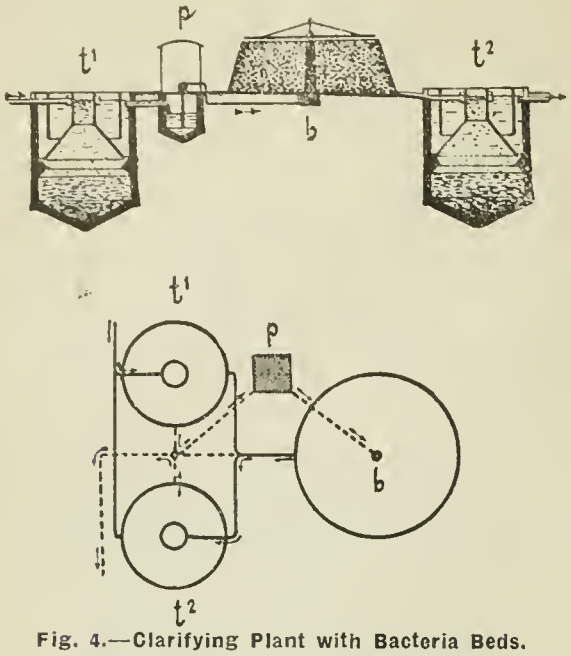



**Fig. 4.—Clarifying Plant with Bacteria Beds.**

If tanks are used for preliminary and subsequent purification in connection with beds, it is of advantage to arrange them so that they can occasionally be interchanged, as shown in Fig. 4, in which $t^1$ is the tank for the preliminary purification, p the pump, b the bacteria bed, and $t^2$ the tank for final purification. This arrangement has the advantage that the sludge of preliminary purification can be directly mixed with that of final purification. Besides other advantages, more uniform decomposition is thereby obtained. The arrangement has the further advantage that the tanks can supplement each other in case of need, rendering special "stand-by" tanks unnecessary.

## SEPTIC TANK PATENT CONFERENCE.

The adjourned meeting of municipalities to discuss what action, if any, should be taken relative to the claims for royalties on the septic tank, was held at the Engineers' Club on the 24th of June last. His Worship Mayor Stavely, of London, Ont., again occupied the chair, and Mr. Willis Chipman again consented to act as chairman. The towns of St. Thomas, Peterborough, Brampton, London, Hamilton, North Bay, and Guelph, were represented. Dr. Hodgetts, of the Ontario Provincial Board of Health, along with several engineers, engaged in sanitary engineering were also present.

Arising out of the last meeting when Mr. Wyllie, of the Septic Tank Company read a statement with reference to the company's demands for royalties, Mr. Macallum, city engineer for Hamilton, called upon Mr. T. Aird Murray, C.E., to read a statement, which several engineers had jointly drawn up, replying to Mr. Wyllie's statement.

As we published the former statement in full in our issue of June 18th, we also publish the text of the engineer's statement which was duly read before the representatives.

The statement is as follows:—

To the representatives of the various municipalities interested relative to the question of claims for royalties in Septic Tank Patents.

We, the undersigned Civil Engineers, having attended a meeting of representatives of municipalities, held at the "Engineers' Club," Toronto, June 10th, 1909; and having heard a statement read at that meeting by Mr. Wyllie, of the Cameron Septic Tank Company, of Chicago, and having further examined the said statement in detail as printed, have met together, and after due consideration have concluded a reply thereto. This reply we have put in the form of a statement and duly signed as mutually agreed upon by ourselves.

We first briefly sum up the leading interesting points, which we consider of importance in Mr. Wyllie's statement:—

**Points in Mr. Wyllie's Statement.**

(a) Mr. Cameron first discovered the scientific principals of the septic process.

(b) That the process is a natural one, but as particularly applied, for the purposes of the elimination of sludge by putrefaction in connection with sewage disposal it is patentable.

(c) That the process has been patented both in the United States and in Canada.

(d) That the process may consist 1st, the so-called anaerobic action of putrefaction by means of which sludge is digested or eliminated. Or, 2nd, the above anaerobic action together with aerobic action, or a further treatment by oxidation of organic ammonia compounds either by means of land intermittent filtration or by means of specially constructed filter beds.

(e) That the main features of the septic process may be summed up in the words of Judge Lacomb, in his decision in the case of Cameron suit against Saratoga Springs, U.S. We quote part of this decision as follows:—

"We, however, are satisfied that Cameron was the first one to subject a flowing current of sewage to the action of anaerobes and aerobes under conditions which secured their separate and successive action. The action of the segregated anaerobes fitting the effluent for subsequent filtration, and aerobic action; and by reason of such careful segregation, he was the first to secure such specified conditions in the anaerobic colony, that its capacity for its natural work was increased to such an extent that it became capable of disposing of practically all future inflowing sludge sewage that entered its workshop without accumulating such a deposit of sludge as would require removal."

(f) That the patents for the above process have been held as valid in the United States.

(g) That no case has as yet been submitted to legal decision either in Great Britain or in Canada.

With reference to this statement, we agree that it is a fair statement of the position of the septic process in the year November, 1907, when Judge Lacombe gave his decision.

With reference to the legal aspect, however, as to how the patents might stand in British or Canadian law, we offer no opinion as we are not lawyers.

On the engineering and general aspect, however, we would offer several remarks, with reference, as follows:—

(a) We cannot agree that Cameron was the first to discover the scientific principals of the septic process. The Cameron process was patented in Great Britain at first in the year 1896. We call attention to the Forse Mouras designed in 1860, here the inlets and outlets are trapped and air excluded from the tanks.

All the putrescible solids were claimed to be liquefied in the tank by anaerobic fermentation allowing of only a slightly turbid liquid.

In 1876, Alexander Muller applied for patent rights for a septic process of tank treatment in which sewage was biologically treated. Air and light were excluded, but it was not claimed that the effluents were purified.

Again in 1891, Scott-Moncrieff constructed what he called a cultivation tank. The whole arrangement is merely a septic tank filled with stones. Scott-Moncrieff claims that he was the first in Great Britain to bring into practical operation any appliance for the claimed purpose of the liquefaction of sludge by putrefaction.

(b) That the process is a natural one, but as particularly applied, etc.

We gather from this and the wording of the United States decision, that there is no claim set up as to a monopoly of septic action. When septic action even in the case of sewage disposal is accidental, and is not particularly applied

for the defined purpose of sludge elimination, there appears to us to be no patent rights.

In the case of the old-fashioned cesspool, covered in and neglected, septic action certainly took place. Such tanks were, however, not designed for the special purpose of sludge elimination by putrefaction, but only as catch pits for solids. Again in many sewerage systems, when gradients are flat and pipes are large, the sewage takes so long to travel to the outlet and so much deposit is formed in the pipes, that septic action is set up in the sewers themselves, and the sewage arrives at the outlet in a highly septic state.

In the case of ordinary continuous flow, sedimentation tanks designed for sedimentation of solids only, by accident or neglect, they may be left unattended to, and septic action naturally is set up without any wish or consideration being given to the benefits, if any, of such action. We take it, that in all such cases no patent rights are implied.

(c) That the process is patented in the United States, in Canada, and in Great Britain also, is taken for granted, but we note that only in the United States has the question been subjected to legal decision. No royalties as such have been apparently collected in Great Britain, and we gather that this is also true in Canada, any payments as royalties appear to have been included or covered by the profits which the company has made in providing apparatus to their clients or in charges made as engineers for supervision of the works. In fact, the company advertise in their printed matter, that when they are directly employed, no royalty charges are made. It would appear, therefore, that there is no precedent in Great Britain or Canada for the payment directly of specific royalty charges.

(d) That the process may consist of: first, septic action only for the elimination of solids, and second, septic action combined with the well-known and understood methods of nitrification, which, of course, are in themselves unpatentable, and previous to the septic patents. This appears to be the meaning of the Saratoga Springs decision. Whether this means that the company can in addition to royalty charges, based on the cost of the septic tank, also claim royalty of the (by itself) unpatentable system of nitrification or aerobic action, when combined with the septic tank, we are not quite clear. If so, it appears a great hardship that royalties can be demanded not only upon the minor and less costly part of a sewage disposal plant, viz., the sedimentation tank, worked intentionally as septic, but also upon the most important and more costly part of the plant, viz., the filtration methods.

(e) The United States' decision in the Saratoga Springs case. This affirms the validity of the process patents.

We would here point out, however, that since this decision was given, further light has been shed upon the whole process of septic action and especially upon the chief benefits which the company claim are connected with the process.

How far any legal decision would be effected by the newer knowledge, we are not so versed in the law that we can give any opinion.

We will, however, here draw attention to the findings contained in the fifth report of the Royal Commission on Sewage Disposal, (Great Britain), the findings of which have recently been further substantiated by the long and careful experiments made at the "Hamburg State Institute of Hygiene," by Professor Dunbar, and further by many other competent and reliable authorities.

The Royal Commission state (page 21, par. 31.):

"The motion that the solid matter of sewage would be digested by passing the sewage through a sealed tank, is by no means novel, but it does not appear to have had any extensive practical application until Mr. Cameron, who held the office of City Surveyor of Exeter, proposed the adoption of the "Septic Tank Treatment" for that city.

"At that time it was claimed that the septic tank possessed the following, among other advantages:—

"That it solved the sludge difficulty, inasmuch as practically all the organic solid matter was digested in the tank.

"That it destroyed any pathogenic organism which there might be in the sewage.

"That sewage which had passed through a septic tank was more easily oxidized than sewage from which the solid had been allowed to settle, either with or without the aid of chemicals, in tanks which were frequently cleaned out."

The Commission conclude on the above claims as follows, (page 229, par. 240):—

"All the organic solids present in sewage are not digested by septic tanks. The actual amount of digestion varying with the character of the sewage, the size of the tank relative to the volume treated, and the frequency of cleaning. With a domestic sewage, and tanks worked at a 24 hour's rate, the digestion is about 25 per cent.

"The liquor issuing from septic tanks is bacteriologically as impure as the sewage entering the tanks."

"Domestic sewage which has been passed through a septic tank is not more easily oxidized in its passage through filters than domestic sewage which has been subjected to chemical precitulation or simple sedimentation."

It will be at once seen that many of our preconceived ideas relating to septic tanks require considerable modification, and in the light of this further knowledge, it will be well to find out just where we stand in regard to the whole matter, before determining to hand over any fees to a company for royalties or patents which have received such drastic criticism by one of the most authoritative pronouncements we can point to.

Not only have the above points been lately substantiated, but Dr. Dunbar, of Hamburg, has shown that with Hamburg sewage, three times the quantity of ordinary sedimentation liquor over that of septic liquor can be treated satisfactorily on the same area of contact beds.

Septic action is not, however, altogether condemned by the Royal Commission, they state (par. 36, page 22):—

"It must, therefore, be said that some of the more important claims which were originally advanced in favor of septic tank treatment, have not stood the test of experience. At the same time, we think that in certain circumstances the adoption of the method of treatment, as a preliminary process, is efficient."

Just where these particular circumstances may occur is a matter of engineering and economic consideration in connection with each particular case. It may be broadly stated, however, as follows:—

(a) When it is not necessary to purify the sewage, but only to remove the grosser solids by precipitation and turn the sewage liquor direct into a source where any nuisance will be minimized by dilution, the benefit of the 25 per cent. reduction in sludge by digestion, may be taken advantage of, and the tank run in long periods without sludge removal and so maintenance cost kept down.

(b) In the case of small installations where the cost of maintenance is a serious item, tanks may be run for say, six to nine months, and the sewage liquor further treated in good open friable land or rough, coarse contact or percolating filters.

Otherwise than in such above cases it would appear desirable to remove the sludge before full septic action commences, say every two months, and convey it to sludge dug out drying beds made in the vicinity of tanks. This would not be necessary in winter, as with our climate practically no septic action takes place in the colder months of the year.

The present known advantages and disadvantages of septic treatment appear to be as follows:—

**Advantages.**

1st.—Elimination or digestion of about 25 per cent. of the sludge retained in the tanks by hydrolisis and gasification.

2nd.—A more solid form of sludge produced in the tanks containing about 80 per cent. of moisture as against 90 per cent. with ordinary sedimentation.

3rd.—The sludge digested into finer particles and less apt to produce a nuisance if used for reclaiming land or filling in purposes.

4th.—A saving in maintenance by the avoidance of frequent removal of the sludge.

**Disadvantages.**

1st.—A constantly increasing quantity of solids given off with the tank liquor as the process is continued. For example, at Burnley, (England), the suspended solids in the liquor varied from 15 parts per 1,000 after a few weeks working to 35 parts per 100,000 at the end of six months. At Huddersefild, (England), the amounts were 6.6 parts per 100,000 at the commencement, and 23.3 parts per 100,000 at the end of eleven months.

At Leeds from January to June, 1903, starting with a perfectly clean tank, the suspended solids averaged to 12.2 parts per 100,000, and from July to December, 1904, the average was 24.1 parts per 100,000, (see Royal Commission Report, page 24). In all of the above cases an increase of over double the amount of solids in the liquor in terms of less than 12 months.

2nd.—The increase of solids tends to choke the filters and render them useless after short periods of time.

3rd.—The effluent sewage liquor is highly charged with sulphureted hydrogen and causes nuisance from smell when sprinkled over filters.

**Septic Tank Treatment as Compared with Ordinary Sedimentation.**

1st.—Septic tanks may be run without removal of sludge for 12 months. Sedimentation tanks should be cleaned out at least once every month.

2nd.—Sedimentation tanks produce as far as the tank liquor is concerned, a liquor of less organic strength.

3rd.—In each case the removal of solids by sedimentation to commence with, is equal from 60 to 70 per cent. With sedimentation tanks the removal is constant if attention to sludge removal be given. With septic tanks the removal is reduced about 50 per cent. after a few months' working.

4th.—With septic treatment, the sludge contains about 80 per cent. of moisture. With sedimentation tanks, about 90 per cent. of moisture.

5th.—Sedimentation liquor is practically odorless. Septic tank liquor is very offensive.

6th.—The cost of sedimentation tanks in the first instance is about 25 per cent. less than septic tanks as they are not required to be so large.

7th.—The cost of maintenance is less in the case of septic tanks than in that of sedimentation tanks, as in the former, the sludge is only removed at long periods, while in the latter, at least once a month.

8th.—Sedimentation liquor is more easily and economically purified by filtration, either in land or by means of biological filters than septic liquor.

From the above it will be seen that there are many considerations to be taken into account before deciding as to whether it is worth while paying any royalty claim in the septic process.

All of the above of which is respectfully subscribed to by:—

A. F. Macallum, City Engineer for Hamilton.

T. Aird Murray, Consulting Sanitary Engineer, Toronto, Adviser to the Provincial Board of Health, Saskatchewan.

O. W. Smith, Consulting Engineer of Messrs. Galt & Smith, Toronto.

A. L. McAlister, associated with Messrs. Macallum & Murray.

Dr. Hodgetts announced that the above statement had been submitted to him and that he considered it a fair and accurate résumé of the present engineering position of the septic tank process.

A general discussion followed, and it was felt that the whole question was assuming great importance, and further that there should be a wider representation of municipalities interested in the question. Up to the present only such towns have been invited who have had notice served upon them by the Septic Company, and the town of Berlin was a notable absentee from the proceedings. Berlin is having a meeting of its own, due to some unfortunate misunderstanding with the secretary as to the nature of the meeting.

Dr. Hodgetts having explained that this question of septic royalties was one which not only affects the towns where such plants are installed, but also such towns such as Cobalt and Palmerston, and others who are anticipating such schemes, as well as all the private septic tanks in Canada.

It was resolved to adjourn the meeting to an early future date, and in the meantime that the secretary, Mr. Willis Chipman, Consulting Engineer, 103 Bay Street, Toronto, notify all parties directly or indirectly interested in the matter. The date of the next meeting will be duly announced in the Review.

## GRADE SEPARATION.

F. L. Somerville.*

Great interest is now being taken in Canada in grade separation. Many of the cities in the United States have had to take the question up and their solution of the problem may be of some interest.

Instead of grouping the works by methods of separation I have taken a few typical cases stated briefly how they dealt with the question, and given references so that fuller information may be secured if desired.

**Allegheny, Pa.** Population, 1900, 129, 896.

Railroad Gazette, Vol. 34, p. 374.

The work in Allegheny was made necessary by the elevation of the Pennsylvania System tracks in Pittsburg, which involved the construction of a new double deck bridge over the Allegheny River, which separates the two towns.

The article is mainly a description of the new bridge, but it says that in Allegheny from Anderson Street westerly the railway passes over Anderson, Sandusky and Federal Streets, from Federal Street the grade is descending westerly, and at Marion Avenue the new elevation is seven feet above the old grade, one half of the street will be depressed, making a subway under the tracks. The level of the track at Ridge Avenue will be unchanged, but beyond that point the track will be lowered (the maximum depression being about 16 feet) at North Avenue and Pennsylvania Avenue. These streets will be raised to go over the railway as will also be done at Washington Street, where the railway will be depressed about 3.5 feet, and the street raised about 16.5 feet.

This is necessitated by the railway passing over rising ground at this point, and the improvement of the grade called for depression at this point.

**Boston.** Population, 1900, 560,892.

Abolition of Grade Crossings on the Providence Division of the Old Colony Railroad in Boston, by J. W. Rollins, Jr. Journal Association of Engineering Societies, Vol. 14, p. 447.

The work will require the elevation of the tracks of the railroad beginning at Massachusetts Avenue, thence rising on a 0.6 per cent. grade to 18 feet above the existing tracks at Roxbury Station, thence the elevation is maintained at from 18 feet to 20 feet above existing grade to Washington Street, Forest Hill, where grade beigns to descend to meet old grade 3,000 feet further south.

This involves a change of 4¼ miles of road over which on three tracks is (1894) handled a daily train service of 186 regular trains, and besides numerous extras, and will necessitate 15 road subways five-foot subways and one overhead bridge. Generally the construction is earth filling between retaining walls.

Separation of Grades of N.Y., N.H. & H. Railway in Boston, Railroad Gazette, Voy. 27, p. 383.

The New Haven road runs through a thickly populated suburban district with large numbers of crossings at grade, and to facilitate traffic and prevent crossing accidents the railway company has decided to elevate its tracks.

*Consulting Engineer, Toronto, Ont.

The general plan is to raise the tracks about 20 feet above old grade, on fill between retaining wall or with turfed slopes where there is room. Street crossings made by steel or iron arch bridges, or stone arches. All floors solid, elevated structure to carry four tracks.

Total cost, $3,500,000, of which railway pays 55 per cent., length 4½ miles.

This is a clear case of railway elevation with down grades at each end to connect with present grades.

Readville, Dedham and W. Roxbury Improvement, Railroad Gazette, Vol. 30, p. 574.

Length, about 7 miles.

All grade crossings abolished.

Cost divided as follows:—55 per cent. to the railways; 18 per cent. to the State; 13½ per cent. each to towns of Hyde Park and Dedham.

Readville is a small village, and tracks were raised and roads altered to suit convenience of railway.

**Boston and Providence Extension.**

Railroad Gazette, Vol. 31, p. 838, 856.

Partly depressed and partly elevated. A large portion of this line is on artificial ground. The Boston and Albany (Boston and Worcester) line built in 1833 was for a long distance surrounded by the water of the bay on both sides and the surrounding submerged flats have been gradually filled in as the city grew. The ground being of this nature the foundations of all retaining walls, bridges, piers, and reconstructed buildings had to be made on piles.

**Buffalo, N.Y.** Population, 1890, 255,664; 1900, 352,587.

Railroad Gazette, Vol. 24, p. 328; Journal Association of Engineering Societies, Vol. 10, p. 422.

There were more than 330 grade crossings in the city each having from 1 to 4 tracks, and one having 13 tracks.

In 1887, Thos. Spencer, Engineer to State Commission, recommended certain work whereby the tracks were to be elevated at interior points and depressed elsewhere, but as this plan was not sufficiently comprehensive, the question was next taken up by a commission of engineers composed of Col. H. Flad, State Engineer Jno. Bogart, G. W. McNulty, A. M. Wellington, Geo. E. Mann, Walker Katti and C. W. Buckholz.

This commission reported in 1888 dealing with 37 crossings, and recommended overhead bridges, elevation of tracks within some cases depression of roadways and the closing of some crossings and diversion of traffic to other crossings. Grades of approaches not to exceed 4 per cent. Minimum clearance for overhead bridges 16 feet and for subways 12 feet.

In 1892 a report was made by E. L. Corthell, of Chicago, and A. W. Locke, recommending the abolition of 76 grade crossings mostly by lowering the streets and raising the tracks.

It is recommended that the streets be maintained at their full width, and the railroads provided with means of passing at full speed to and from their stations, that but few streets be closed, and that the present ruling grades for streets in the various sections of the city should not be increased and that 3 per cent. be the maximum grade.

The report also says, "When sidings are not too numerous it will sometimes be found to be cheapest to raise or lower the tracks rather than to confine the change altogether to the streets. In cities the latter plan is apt to entail large expense for damages done to adjoining states, while as a general thing, damages for changes in the grade of the railroad cannot be recovered by adjoining owners.

**Brockton, Mass.** Population, 1900, 40,063.

From Journal Association of Engineering Societies, Vol. 14, p. 420.

Population, 30,000. Area, 20 square miles. Date of report, September 21st, 1892.

Town is rectangular in shape approaching a square through the centre of which runs the Old Colony Road.

Within the city limits are three stations with freight yards and houses: Montello, Brockton and Campbell, as in most manufacturing towns, the growth has been along the line of the railway; gradually streets have been laid out across the tracks, all at grade, and public ways, so that at the present time there are eleven crossings at grade over which the public have rights. The freight yard at Brockton is at present in the centre of the city, and over which freight cars have to be shifted across the principal streets.

When the grade crossing law was passed in 1890, Brockton was the first city to take advantage of it. After long discussion an agreement was reached in June, 1893, to raise the grade of railway through the centre of the city 12 feet, and to depress through Campbell about 8 feet. The plans as finally adopted were:—

The grade of the railways to be raised for 9,000 feet with a maximum rise of 15 feet, and to be lowered for 5,100 feet with a maximum lowering of 12 feet. All stations to be double with a main station on the west side of the tracks, and a waiting station on the east track with subways under the tracks connecting the two stations. The changes decided upon require 7 arches over streets, 2 arches over streams, 4 subways for pedestrians, 2 plate girders over streets, and 8 highway bridges over the railroad.

The main freight yard at Brockton covers about 40 acres, and will be 24 feet below grade of tracks as raised, and will be approached by switchback with about 800 feet of tail track with grades ranging from 1.2 per cent. to 0.4 per cent. All streets will have to be changed more or less to get under or over the tracks in many cases involving other streets, and necessitating changes in water and gas pipes.

The cost to be divided as follows:—Railway Company, 65 per cent.; State, 25 per cent.; city, 10 per cent.

**Chicago.**

The 40th Street Track Elevation of the Chicago Junction, Railroad Gazette, Vol. 44, p. 243.

The Chicago Junction is a switching road, the chief function of which is to handle the Union Stock Yard business.

The 40th Street line runs east to connection with the Illinois Central on the lake front and crosses the Lake Shore and Michigan Southern, the Chicago, Rock Island and Pacific, the Pittsburg, Ft. Wayne and Chicago, and the Chicago and Western Indiana, all of which secure connection to the Stock Yards through it. Built some 30 years ago it is now in a closely-built section of the city occupying the larger part of the thoroughfare from which it takes its name.

In doing the work of separation of grades, the Chicago Junction, under agreement with the South Side Elevated, built extra lines on 40th Street, which they will lease to the elevated road.

The elevation of the 40th Street line extends from the Lake Shore to Union Street two blocks from the Stock Yards, where it swings southward to enter the yard.

Commencing at the east end of the Illinois Central, where there are some team tracks the grade rises to Drexell Boulevard with two tracks as far as Wentworth Avenue; four tracks from Wentworth Avenue to Butler, and six tracks from Butler to Stock Yards.

The line generally is built with solid embankments between retaining walls, and has bridges with solid ballasted floors.

The line passes over the Lake Shore and the Rock Island tracks which are already elevated (the grades approaching the crossing being 1.3 per cent., and the clearance 18 feet), and passes under the P. F. W. & C., and the Western Indiana which have been elevated. There appear to be 25 subways for street crossings. From there it falls on a 1.3 per cent. grade to pass under the P. F. W. & C., and the Western Indiana which have been elevated.

Twenty-five streets appear to be crossed by these tracks all in subways.

**Chicago.**

Engineering News, Vol. 43, p. 24, January 11th, 1900.

### Progress of Track Elevation at Chicago.

An article on the above subject gives the following table:—

| Track Elevation. | Length of track in miles. | Length of main tracks miles. | No. of cross-ings eliminated. | No. of subways built. |
|---|---|---|---|---|
| A. T. & F. Ry. ..... | 1.75 | 3.50 | ... | .. |
| C. & Alton R. R..... | 0.65 | 0.65 | ... | .. |
| C. & N. W. Ry. ..... | 14.85 | 60.00 | 150 | 96 |
| C. B. & Q. R. R. .... | 2.75 | 11.00 | 14 | 16 |
| C. M. & St. P. Ry. ... | 8.40 | 18.30 | 33 | 29 |
| C R. I. & P. Ry., & L. S. & M. S. Ry. .. | 5.50 | 22.00 | 32 | 32 |
| C. R. I. & P. Ry. (alone) ..... | 1.80 | 3.60 | 15 | 14 |
| L. S. & M. S. Ry. (alone) ..... | 0.90 | 1.80 | 2 | 3 |
| Ill Cen. R. R. ..... | 3.00 | 30.00 | 19 | 26 |
| C. M. & N. Ry. ..... | 1.00 | 2.00 | .. | .. |
| S C. Air Line ..... | 1.25 | 2.50 | 3 | 3 |
| P C. C. & S. L. R. (1.330 miles) included in C. & N. W. Ry. ..... | | | | |
| P. Ft. W. & C. Ry. ... | 2.50 | 10.00 | 15 | 15 |
| Total Elevation ..... | 44.00 | 165.35 | 283 | 234 |
| **Tracks Depressed:—** | | | | |
| A. T. & S. F. Ry. & C. & W. I. R. R. ... | 0.50 | 10.00 | 2 | 2 |
| C. M. & St. P. Ry. ... | 0.50 | 0.50 | . | . |
| Illinois Central Ry. .. | 2.00 | 52.00 | . | . |
| Total Depression .... | 3.00 | 62.50 | 2 | 2 |
| **Work Provided for—** | | | | |
| A. T. & S. F. Ry. & C. M. & N. Ry. ..... | 2.84 | 12.30 | | |
| C. & Alton Ry. ..... | 4.50 | 13.50 | 56 | 40 |
| P. C. C. & St. L. Ry., C. T. T. R. R. & W. St. Yds. & Co. | 1.27 | 3.50 | | |
| P. Ft. W. & C. Ry., & W. L. R. R., Gd. T. R. & W. St. Yd. Co. ..... | 4.00 | 16.00 | 75 | 75 |
| Total work provided for ..... | 12.61 | 45.23 | 131 | 115 |
| Total work done and provided for .... | 56.96 | 273.08 | 416 | 351 |

**Nottingham.** Population, 1901, 239,743.

Proceedings, Inst., C.E. Great Central Railway, England. Northern Division.

A viaduct carries the railway across part of the town and passes over a number of streets, a canal and the tracks of the Midland Railway. For the rest of the town the track is principally in tunnel or cutting with a few overhead bridges.

At Loughborough (population, 1901, 21,508), the track is elevated, and at Leicester (population, 1901, 211,579), it is carried on a viaduct. A right-of-way occupation road crosses the line at grade about a mile south of Leicester, this being a special case, and the only grade crossing on the 52 miles of line.

Generally, this railway runs at right angles to the run of the ridges and valleys which caused heavy work in deep cuts or tunnels and high fills or viaducts.

**Jersey City, N.J.** Population, 1900, 206,433.

Erie Track Elevation. Railroad Gazette, Vol. 29, page 74.

All grade crossings to be abolished which necessitates the elevation of the tracks from mouth of Bergen Hill Tunnel to the Terminal Yard at the water front. The crossing overhead of six streets and the closing of three streets.

The new grades will be much worse than the old ones, the main line between Henderson Street and the trainshed falling 0.832 per cent.; the elevated branch falling 1.75 per cent.; and the freight yard branch falling 2.49 per cent. to overcome which it will no doubt be necessary to elevate the yards between Henderson Street and the docks. The Engineering News (Vol. 57, page 204, February 21st, 1907), in describing the construction of a new four-track line through Bergen Hill, partly in open cut and partly in tunnel, says "the Erie looks forward to elevating its tracks, passing through the low lying portion of the city to the east of Bergen Hill."

**Pennsylvania Railroad Terminal Improvement.**

Engineering News, Vol. 24, page 572, December 27th, 1890.

The work comprises the construction of a four-track viaduct about 3,000 feet long, replacing oil surface tracks and grade crossings. This elevated structure runs from Bergen Hill to Henderson Street, and from there to the end of track the surface has been elevated by filling to height of 15 to 20 feet above the former surface. Heavy retaining walls support the embankment on all sides. Total area elevated covers about 55,000 square yards, requiring 350,000 cubic yards of filling.

**Montreal, Que.** Population, 267,730 in 1901.

Transaction of Canadian Society of Civil Engineers, (February 15th, 1900).

Ontario Street subway carries street under ten tracks of the C.P.R. at Hochelaga, width of subway 40 feet over all, with 3 feet wall and posts in the centre, leaving two roadways 13 feet and 6 inches, and two sidewalks 5 feet wide.

Brock Street tunnel built from Craig Street to wharf to eliminate the climb to and from Notre Dame Street passes under C.P.R. tracks.

Notre Dame Street viaduct carries the street over the tracks of the C.P.R. leading to Place Viger Station.

**Milwaukee, Wis.** Population, 1900, 285,316.

Engineering News, March 9th, 1905.

The problem of separation of grades is being taken up for the following reasons:—

1st.—Elimination of danger due to grade crossings.

2nd.—Elimination of delay to street traffic (including fire department equipment.)

A commencement has been already made, one piece of the line has been depressed, an ordinance has been passed and accepted, for the elevation of another line, and preliminary arrangements made in regard to other lines so that the work of eliminating the grade crossings will be spread over a number of years.

**Track Depression.**

The part already done is the depression of the main line of the C. & N. W. Railway where it passes through the north-east part of the city. This line has three tracks, but the width between retaining walls and abutments is made for four tracks. Part of the line has retaining walls on both sides, or on one side only, the remainder being through ordinary cuts with some side hill work along the Milwaukee River. The maximum depression is 18 to 20 feet, and the city lowered the sewers and water mains so as to place them about five feet below sub-grade.

**Track Elevation.**

The C. & N. W. Railway has accepted an ordinance providing for the elevation of the tracks of its Madison Division in the south-east part of the city, from the city limits to Greenfield Avenue. An ordinance is pending for the elevation of the C. M. & St. P. Railway tracks, which parallel those of the C. & N. W. Railway from Lincoln Avenue to Greenfield Avenue, including part of the spur connecting with the Chicago line of the latter railway. Negotiations are also in progress in regard to the lines of the C. M. & St. P. Railway running west from Union Station.

Work is held up as the Federal Government has decided to improve Kenneckennie River, and until the new harbor lines as established, the railways cannot definitely locate their bridges.

The ordinance covering the work of the C. & N. W. Railway in the south-east part of the city specifies that embankments may have side slopes or retaining walls and cross streets and alleys must be crossed with steel girder bridges supported on concrete or masonry abutments or upon rows of iron or steel columns braced together laterally and founded on masonry foundations built within the limits of the right-of-way and in the centre and curb lines of the streets. Solid floors or open floors may be used, but for the latter some means must be provided to prevent dirt dropping in the subway. The subways to have a clear headway of 12 to 13½ feet. Some streets will be lowered at the subways with a maximum grade of 4 per cent. and vertical curves at head of approaches. Paving of subways to be brick with cement sidewalks. Railway company to pay for all the above, except where street railways cross when paving must be paid for by the latter.

If additional subways are required in the future they are to be built by the railway and paid for by the city. The city pays no part of the expense but agrees to defend any suit brought against the city or railway for damages by adjacent property or business claimed to result from the execution of the work.

(To be Continued Next Week.)

## RAILROAD ORDERS.

(Continued from Page 4.)

7283—June 18—Extending for a period of one year from the 31st of June, 1909, the time for the use of the crossing by the Victoria, Vancouver and Eastern Railway, at rail level, of its railway by the track of the British Columbia Electric Railway at Park Avenue, in the city of Vancouver.

7284—June 8—Authorizing the C.P.R. to construct a spur at Mile End, town of St. Louis, District of Montreal, Que., on the premises of Messrs. Hyde & Webster.

7285—June 8—Dismissing application of Joseph Ethier, Montreal, to amend Order of the Board, dated January 23rd, 1905, authorizing the G.T.R. to take certain lands, then the property of the city of Ste. Cunegonde, Que.

7286—June 18—Approving deviation, change, and alteration in main line of the C.P.R., near Steel Siding, District of Thunder Bay, Ont.

7287—June 18—Granting leave to the Vancouver and Lulu Island Railway to construct its Westminster and Eburne Branch across the Trapp Road at Station 425, and across the Byrne Road at Station 355, District of Burnaby, B.C

7288 to 7290—June 18—Granting leave to the Toronto Suburban Railway Co. to erect, place, and maintain its electric wires across the track of the C.P.R. and G.T.R., in the Township of York, County of York, Ont.

7291 to 7293—June 9—Granting leave to the corporation of the city of Edmonton, Alberta, to cross at level with its lines the lines of the G.T.P. and C.N. Railways at the intersection of the lines of said companies at Alberta Avenue, Edmonton; to erect, place, and maintain necessary poles and wires to transmit power across the G.T.P. and C.N. Railways at the intersection of the lines of the said companies at Alberta Avenue, Edmonton; and to cross the lines of the G.T.P. and C.N. Railways at the intersection of Syndicate Avenue at or near its intersection with Griesbach Street, Edmonton, Alta.

7294—June 17—Reporting to the Governor-in-Council for sanction by-law of the Bay of Quinte Railway re spitting in cars or on railway premises.

7295—June 14—Approving additions and changes in proposed Supplement No. 1 to the Canadian Freight Classification No. 14, with one or two exceptions.

7296—June 19—Approving proposed station layout of the C.N.R. at Saskatoon, Sask.

7297—June 19—Directing the Grand Valley Electric Railway to fence certain portions of its line within sixty days from date of Order.

7298—June 19—Dismissing application of the C.P.R. for Order directing the G.T.R. to receive passenger and baggage cars of C.P.R. and deliver same to the C.P.R. at point of junction of tracks of the Ottawa, Northern and Western Railway with the tracks of the Canada Atlantic Railway, near Sapper's Bridge, Ottawa, Ont.

7299—June 16—Directing the Western Counties Electric Co. before July 1st, 1909, to erect, place, and maintain its wires across the railway and telegraph wires of the G.T.R. at the Elgin Street Subway, Brantford, Ont.

7300 and 7301—June 17—Granting leave to the Beggy Creek Rural Telephone Co., Limited, to erect, place, and maintain its wires across the track of the C.N.R. between Sections 1 and 2, Township 19, Range 21, west second meridian, Saskatchewan, and between Sections 23 and 26, Township 19, Range 21, west second meridian, Saskatchewan.

7302 and 7303—June 21—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. in the centre of Bow Island, and just west of Grassy Lake, Alta.

7304—June 19—Granting leave to the Bell Telephone Co. to erect, place, and maintain its wires across the P.M.R.R. at Talbot Street, St. Thomas, Ont.

7305—June 17—Granting leave to the municipality of the village of Streetsville, Ont., to erect, place, and maintain its electric light wires across the track of the C.P.R. at Tannery Street, Streetsville, Ont.

7306—June 18—Authorizing the G.T.R. to construct, maintain, and operate branch lines on certain streets in the town of Sarnia, Ont.

7307—June 18—Authorizing the C.P.R. to construct, maintain and operate spur in the town of Gonor, Man., to and into the premises of the Government of Manitoba.

7308—June 18—Granting leave to the Shawinigan Water and Power Co. to erect, place, and maintain its transmission wires across the track of the Q.M. and S.R., near St. Gregoire, Que.

7309—June 19—Authorizing the C.P.R. to construct, maintain, and operate branch line of railway at Kamloops, B.C.

7310—June 18—Authorizing the C.P.R. to construct Bridge No. 34 over the Yamaska River, Drummondville Section (Eastern Division), of its line of railway.

7311—June 21—Approving and sanctioning location of the C.N.R through the Townships of Himsworth and Nipissing, District of Parry Sound, Ont.

7312—June 21—Approving location and detail plans of the C.P.R. Co.'s standard No. 4 Station at Moffat, County of Wellington, Ont.

7313—June 21—Approving location of the C.P.R. Co.'s station at Mountain, Ont.

7314—June 21—Authorizing the G.T.R. to connect its main line track, on the east side of the Potowotamie River, Township of Grey, Ont., with sidings of the Owen Sound Portland Cement Co., Limited, Owen Sound, Ont.

7315—June 21—Approving change in location of the E. and N.R. Co.'s line from mileage 100 to 127, Alberni Branch.

7316—June 21—Granting leave to the London Township Telephone Co. to erect, place, and maintain its wires across the track of the London, Huron and Bruce Branch of the G.T.R. at public crossing on the Town Line between MacGillivray and Biddulph Townships, two miles north of Denfield Station, Ont.

7317—June 19—Rescinding Order No. 6520, dated March 15th, 1909, approving plans of the crossing of the track of the C.P.R. by the track of the London Street Railway Co. at Richmond Street, London, Ont.; and the C.P.R. is directed to serve forthwith upon the London Street Railway plans of the interlocker proposed to be installed at the said crossing.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Prince Edward Island.**

CHARLOTTETOWN.—Tenders will be received up to Monday, July 12th, for the construction of a 20 stall, brick and concrete engine house, foundation for turntable, foreman's office and lavatories. Plans may be seen at the Resident Engineer's Office, Charlottetown, at the office of the Chief Engineer, Moncton, N.B.. M. J. Butler, Chairman, Ottawa, Ont.

**New Brunswick.**

SACKVILLE.—Tenders for the erection of a new ladies' college will be received up to July 7th, 1909. B. C. Borden.

PINK ROCK.—Tenders will be received until Monday, July 5th, for the construction of a Wharf Extension and Breakwater at Pink Rock. Plans can be seen at the offices of E. T. P. Shewen, St. John, N.B., and Geoffrey Stead, Chatham, N.B. Napoleon Tessier, Secretary Public Works Department, Ottawa, Ont.

**Quebec.**

ST. LOUIS.—Tenders will be received until July 2nd for concrete to be used as foundation for sidewalks. J. Emile Vanier, Town Engineer, 5 Beaver Hall Square, Montreal.

**Ontario.**

BRANTFORD.—The City Engineer, T. Harry Jones, will shortly ask for tenders for pavement work, sidewalks, curbs, and gutters.

NORTH BAY.—Tenders for Customs and Inland Revenue fittings will be received until Monday, July 12th, 1909. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received until July 12th, for the construction of concrete storage and regulating dams near Port Arthur. H. F. McNaughten, Secretary, Department of Public Works. (Advertized in the Canadian Engineer.)

MOOSE CREEK.—Tenders will be received until July 12th for excavations for a drain. Estimated cost, $5,000. F. D. Brunet, Township Clerk.

WELLAND.—Tenders will be received until July 5 for additions to schools. Ellis & Connery, architects, Toronto. J. McCaw, secretary, School Board.

CHAPLEAU.—Tenders will be received until July 5th for waterworks equipment. W. H. Farrell, Town Clerk. Willis Chipman, C.E., 103 Bay Street, Toronto. (Advertised in The Canadian Engineer.)

METAPEDIA.—Tenders will be received until Friday, July 9, for the construction of approaches to the highway bridge across the Restigouche River at Metapedia, Province of Quebec. Plans can be seen at the offices of E. T. P. Shewen, Resident Engineer, St. John, N.B.; C. E. W. Dodwell, Resident Engineer, Halifax, N.S.; J. L. Michaud, Resident Engineer, Merchants Bank Building, Montreal, Que., and at the office of the Chief Engineer of the Intercolonial Railway, Moncton, N.B. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

FORT WILLIAM.—Tenders will be received until July 5th for electric wiring and fittings in Post Office building. Address, W. T. Rankin, Fort William, or Napoleon Tessier, Secretary, Public Works Department, Ottawa, Ont.

TORONTO.—Tenders will be received until Monday, 5th July, for concrete foundation work in connection with the extensions to the Ontario Government Buildings. H. F. McNaughten, secretary, Department of Public Works. (Advertised in the Canadian Engineer.)

OTTAWA.—Tenders will be received until July 15th for the supply of coal for the Public Buildings throughout the Dominion. Napoleon Tessier, Secretary, Department of Public Works.

**Manitoba.**

WINNIPEG.—Tenders of brass and galvanized fittings for meter installation will be received up to Friday, July 2nd, M. Peterson, Secretary, Board of Control.

WINNIPEG.—Tenders will be received up to Saturday, July 3rd, for all the work involved in the grading of the spur line. The entire work involves:—Clearing, 5.1 acres; grubbing, 0.4 acre; close cutting, 0.8 acre; earth excavation, 3.073 cubic yards; rock excavation, 3,600 cubic yards; cedar culverts, 6,000 feet, B.M.; ties (half tamarac), 1,900 (6-in. x 6-in. x 8ft.). M. Peterson, Secretary, Board of Control.

WINNIPEG.—Tenders will be received until August 2nd and August. 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chase, engineers, Toronto and Winnipeg; Wm. Kennedy, jr., Y.M.C.A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

**Saskatchewan.**

REGINA.—Tenders will be received until July 19th, for a supply of sewer pipe. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

MOOSE JAW.—Tenders will be received up to Monday, 18th July:—1-50 light, constant current transformer or regulator, with 35 arc lamps and suitable switchboard, with necessary instruments for controlling same; one year's supply of Watt meters; one' year's supply of transformers. John D. Simpson, City Clerk.

REGINA.—Tenders will be received until July 19th, for concrete pavements, curbs, and sidewalks. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for a supply of pipes and valves for waterworks system. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

NORTH BATTLEFORD.—The time for receiving tenders in connection with the proposed waterworks and electric lighting systems has been extended to July 9th. Willis Chipman, C.E., 103 Bay Street, Toronto.

**British Columbia.**

VICTORIA.—Tenders will be received up to Monday, 16 August, for the supplying of cast iron water pipe, pig lead, gate valves, for waterworks. W. W. Northcott, Purchasing Agent.

VICTORIA.—Tenders will be received up to Saturday, 10th July, for the cables and metal required in connection with a Suspension Bridge over the Fraser River, to be delivered at Lytton, B.C. F. C. Gamble, Public Works Engineer.

FERNIE.—Tenders will be received until July 2nd for the installation of water supply, including 14,000 feet of 12-inch wood stave pipe line and a concrete dam. Robert Potter, City Engineer.

## FINANCING PUBLIC WORKS.

**Quebec.**

LACHINE.—The City Treasurer invited tenders for municipal bonds amounting to $115,000.

HULL.—A by-law to be submitted to the ratepayers shortly includes $22,000 for waterworks extensions and $30,000 for new pumps.

**Ontario.**

PICTON.—The County Treasurer of Prince Edward solicits tenders for $35,000 good roads debentures.

CHAPLEAU.—This municipality offers for sale $31,000 waterworks debentures. W. H. Farrell, clerk.

BERLIN.—The ratepayers have sanctioned a by-law to provide $19,000 for double tracking a portion of the line between Berlin and Waterloo.

AURORA.—Tenders are invited by this municipality for $4,800 debentures, including $1,200 for artesian wells. G. H. Lundy, clerk.

**Manitoba.**

WINNIPEG.—The ratepayers will shortly vote on a by-law of $400,000, for three bridges.

VIRDEN.—The municipality of Wallace asks for tenders for $20,000 telephone debentures.

CARMAN.—Sewer and waterworks debentures aggregating $25,000 are offered for sale by this municipality.

WINNIPEG.—A by-law for $400,000, for three bridges, and others, aggregating $600,000, were passed recently by the property owners of Winnipeg.

**Saskatchewan.**

REGINA.—J. Kelso Hunter, city clerk, invites tenders for debentures amounting to $313,600, including electric light, waterworks, sewerage and other local improvements.

**Alberta.**

MEDICINE HAT.—School debentures amounting to $50,000 are offered for sale by School District No. 76.

**British Columbia.**

FERNIE.—The by-laws to raise $15,000 for a new fire hall and $15,000 for parks have been passed.

## MISCELLANEOUS.

**Ontario.**

TORONTO.—The University of Toronto has applied for a permit to erect the library building, the excavation work of which has been begun. The building will cost $175,000.

**British Columbia.**

VANCOUVER.—Frederick J. L. Tytler, M. Can. Soc. C.E., has outlined plans for a bridge to be erected across the first narrows at Prospect Point. The span, from tower to tower will be 1,250 feet.

**Foreign.**

BUFFALO, N.Y.—The report of the International Waterways Commission, which is almost ready, will recommend, it is said, the building of a dam across the Niagara River to raise the level of the Great Lakes.

## CONTRACTS AWARDED.

**Nova Scotia.**

SYDNEY.—The following tenders were received for erecting the new fire hall: Rhodes, Curry & Co., $12,800; F. L. Dixon, $13,700, and Chappell Bros., $16,000. The lowest was accepted.

HALIFAX.—Stairs, Son & Morrow, Limited, have been awarded a contract for valves by the city council.

**New Brunswick.**

FREDERICTON.—The Hassam pavement contracts awarded recently to Mr. R. S. Low, of Sydney, by the city council, amount to $6,164.

**Quebec.**

MONTREAL.—Hyde and Webster have been given a contract for Metropolitan paving blocks at $45.50 a thousand by the Montreal council.

MONTREAL.—At a recent meeting of the Westmount City Council in connection with the extension of the electric plant, the following tenders were accepted: Canadian Westinghouse Company, switchboard, $1,285; John McDougall Caledonian Iron Works, cooling tower, $2,900; Darling Bros., feed water heater, $700; Canadian Crocker-Wheeler Company, generator and accessories, $4,650; Belliss & Morcom, Birmingham, England (Laurie & Lamb, agents), compound condensing engine, etc., $7,000.

**Ontario.**

TORONTO.—The Canada Foundry Company have been given a contract for 31,080 feet of 12 inch pipe for water mains, by the Board of Control.

LONDON.—The joint committee appointed by Middlesex and Lambton counties have awarded the contracts for the Thedford bridge over the Aux Sauble River. The tenders called for a steel superstructure and concrete flooring, and abutments. The span of the bridge is to be 140 feet. The contract for the steel work was awarded to the Stratford Bridge Company at $3,410, and for the concrete work to Lev. Crouse, of this city, at $1,380.

**Manitoba.**

WINNIPEG.—The contract for supplying and installing the electric lighting fixtures in the Fort Garry depot has just been let to the Robert Mitchell Company, Limited, of Montreal. It covers all chandeliers and lights, exclusive of the wiring, which is covered by a separate contract, and involves a sum in the neighborhood of $30,000.

**Alberta.**

CALGARY.—The City Council asked for tenders from local manufacturers for supplying a smoke stack for the power house, and received the following: Alberta Culvert Company, $350; Union Iron Works, $265; Calgary Iron Works, $240. The lowest was accepted.

**British Columbia.**

FERNIE.—The contract for the new court house, $70,000, went to James A. Broley, a local contractor.

VICTORIA.—Tenders for the paving of Wharf Street, the city to supply the brick, were opened at a recent meeting. The tenders were Luney Bros., $23,550; Cameron Co., $16,766.63; Steadham, Sabine & Stevens, $12,945.

## RAILWAYS—STEAM AND ELECTRIC.

**Nova Scotia.**

PORT WADE.—Engineers are at Port Wade making a survey for the proposed increased facilities for the H. & S. W. Railway.

**Quebec.**

MONTREAL.—The Canadian Northern Railway's line from Montreal to Quebec will be formally opened July 15th.

**Ontario.**

OTTAWA.—The minister of railways has approved of the route map of the G.T.P. branch line from Regina to North Portal, and the C.N.R. branch from Maryfield to Lethbridge. The latter line is directed to pass through Carlyle, Sask., instead of through Manor.

SANDWICH.—The town of Sandwich recently complained of the service given by the Sandwich, Windsor and Amherstburg Railway, and the question of their right to use the streets was disputed. The original agreement between the parties was destroyed by fire some 30 years ago. According to the decision of the Ontario Railway and Municipal Board, the agreement expires on December 15th, 1912. The point will be decided by the Court of Appeal.

PORT ARTHUR.—The city council have decided to construct an extension of the street railway, and tenders will shortly be invited for material and labor. J. J. Antomiser is the city engineer.

**Manitoba.**

WINNIPEG.—The G.T.P. track will be laid into Edmonton by July 7. Gangs are now 48 miles from that city, but the strength will be doubled and they will now be able to lay four to six miles per day. The line will be 794 miles between this city and Edmonton.

WINNIPEG.—Mr. Merry, C.E., will probably secure the contract for the construction of the first section of the North Battleford-Athabasca Railway, to be built by the Canadian Northern Railway. He is concentrating his outfit and supplies at North Battleford, preparatory to an early start.

WINNIPEG.—The work of laying the 80-pound steel between Port Arthur and Winnipeg on the Canadian Northern

line will be under way within the course of a week's time. The first of the new steel for the line arrived in Port Arthur recently. A large number of men have been working, and a number of work trains have been on the work of preparing the track.

**Saskatchewan.**

CARLYLE.—The construction of the Merryfield-Lethbridge branch of the C.N.R. began on 25th June.

MELVILLE.—Several hundred men are now at work on the Melville-Regina line, which is being built by McMillan Bros. & Kenny, and the Melville-Yorkton, which Rigley & Hyland will construct. By the end of the week 1,000 men will be at work.

**Alberta.**

EDMONTON.—The contract for the construction of two hundred miles of the G.T.P. between the McLeod River and the mountains has been let to Foley, Welsh & Stewart, and the work is to begin shortly.

**British Columbia.**

FERNIE.—A large party of railway surveyors is being outfitted to take the field next week for the purpose of surveying the line of the Canadian Western Railway, which is to run from Calgary to the international boundary.

## CEMENT—CONCRETE.

**Prince Edward Island.**

CHARLOTTETOWN.—Tenders are invited for the construction of a 20-stall engine in which concrete will be used. Address, the Resident Engineer, P.E.I., Railway.

**Quebec.**

ST. LOUIS.—This municipality wants tenders for a concrete foundation for asphalt sidewalks. J. Emile Vanier, Town Engineer, 5 Beaver Hall Square, Montreal.

**Ontario.**

LONDON.—Lev. Crouse, of London, has secured a contract for the concrete abutments and flooring, at $1,380, for a bridge to be erected over the Aux Sable River.

TORONTO.—Elsewhere in this issue appears an invitation for tenders for the construction of concrete dams, near Port Arthur. The work will be done by the Department of Public Works of Ontario.

**Saskatchewan.**

REGINA.—This municipality has decided to construct 5,000 square feet cement sidewalk, 1,000 lin. feet curb and gutter and 1,225 square yards pavement, for which tenders will be received until July 19th. Angus Smith, City Engineer.

**British Columbia.**

FERNIE.—Tenders are wanted for the construction of a concrete dam in connection with waterworks here. R. Potter, City Engineer.

## SEWERAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—The John McDougall Caledonian Iron Works have just completed the installation of a Worthington pump, which will discharge thirteen million gallons into the city water mains every twenty-four hours.

**British Columbia.**

NEW WESTMINSTER.—Plans for a new 24-inch main from Coquitlam Lake to this city were outlined at a council meeting, on June 17, by Mr. H. M. Burwell, of Hermon & Burwell, consulting engineers. Mr. Burwell will make a preliminary survey and prepare an estimate of the cost of a new main for approval at the next meeting.

VICTORIA.—W. W. Northcott, purchasing agent, invites tenders for cast iron pipe, pig lead and gate valves, in connection with waterworks extensions.

**Alberta.**

WETASKIWIN.—The first sod was turned on June 12th in connection with the waterworks system which is being installed here by Galt & Smith, consulting engineers, of Toronto. Mr. E. L. Miles is engineer-in-charge.

## LIGHT, HEAT, AND POWER

**Ontario.**

ST. THOMAS.—D. W. Yates Hydro-Electric Commission's engineer, submitted to the City Council the estimates of the cost of constructing a plant for the distribution of Niagara power. For an entire new plant for all purposes his figures were $83,620, with alternate propositions, which would mean the remodelling of the present plant for $82,810. The Council decided to accept the former proposition, and will ask the ratepayers to sanction the expenditure.

## CURRENT NEWS.

**Ontario.**

OTTAWA.—Dr. W. F. King, Canadian Boundary Survey Commissioner, has received a telegram from British Columbia telling of the death of a young man named Sheppard, a member of a survey party now re-marking the Alaska boundary. Sheppard, who lived in Nanaimo, was caught in an avalanche and carried down to the valley, 2,000 feet below. The body has not yet been recovered.

BRANTFORD.—City Engineer Jones visited Hamilton, Ont., recently and inspected various kinds of pavement and material.

## TELEPHONY.

**Saskatchewan.**

MELVILLE.—The Provincial Government will install a local telephone system at once, with connection with the long distance telephone system.

**Manitoba.**

NEEPAWA.—A construction gang is here building lines and installing telephones contracted for some time ago.

## PERSONAL.

MR. COLLINGWOOD SCHREIBER, chief consulting engineer of the G.T.P. will leave for the West in a few days on an inspection trip over the G.T.P. to Prince Rupert.

MR. LEWIS M. HAUPT, C.E., of Cleveland, Ohio, when in Toronto this week called at the Canadian Engineer's offices.

MR. T. L. DATES of the Sun Portland Cement Company, of Owen Sound, has just returned home from a successful business trip through the West.

MR. T. AIRD MURRAY, Consulting Engineer, of Toronto, has gone West to make his first report on various sanitary schemes submitted to the Provincial Board of Health of Saskatchewan.

MR. RODERICK J. PARKE, A.M., Amer. Inst. E.E., A.M. Can. Soc. C.E., Canadian manager of the British Aluminum Company, Ltd., Bank Toronto Building, Toronto, has returned from a three months' trip to Europe.

MR. HUGH LUMSDEN, chief engineer of the National Transcontinental Railway Commission, has resigned. Mr. Lumsden has been chief engineer of the Commission since its organization five years ago, and his resignation will be a great loss.

The tonnage of ore mined in 1908 in British Columbia was the largest ever produced by the Province, and the average assay of the ore also slightly greater than that of 1907, but the average market value of the various metals for the year was much lower, which accounts entirely for the decreased value of this year's output; since the drop in the market price of metals amounts to some $3,966,826.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que.; Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Society of Civil Engineers.**—Annual convention, Mount, Washington Hotel, Bretton Woods, N.H., July 6 to 9. Secretary, Chas. W. Hunt, 220 West 57th Street, New York.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**National Irrigation Congress.**—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

**League of American Municipalities.**—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé, R.S.A.; P.O. Box 259, Montreal, Que.

(Continued from Page 4.)

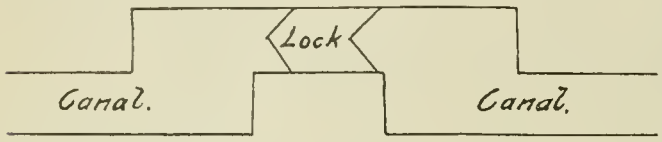
Section 42 specifies a shop coat of approved paint. It may be hopeless to try to get the engineering profession to agree on an approved paint, but probably red lead would more nearly satisfy the ideas of most members than any other kind.

The specification has covered only the work of the designer and manufactured of tanks, but, inasmuch as most contracts for tanks and stand-pipes, especially for municipalities, include their erection, it would seem desirable to give specification for erection, testing, and field painting.

It is to be regretted that the author did not see fit to give some text with the specifications.

## SUGGESTIONS FOR CANAL LOCK.

Sir,—In re the question of preventing damage to lock gates, it appears to me that in the case at least of large and important canals, the locks might be located off the centre line as shown on the sketch. This would oblige boats approaching the lock to come to a dead stop and be towed




broadside into position. The extra expense of construction and loss of time in manipulation would probably not be so great as would at first sight appear. The idea must have occurred to many people, and I would be glad to have the opinion of those who are more conversant with the matter than I can claim to be. Yours truly,

Alexander G. Craig.

Peterborough, June 19th, 1909.

## A NOTABLE MUNICIPAL REPORT.

A municipal report of more than ordinary interest is about to be issued by the city of Boston in the shape of a volume of over 1,200 pages, comprising nearly sixty individual reports made by Metcalf & Eddy, consulting civil engineers, of Boston, to the Finance Commission which recently completed its labors. In the course of this investigation the engineers studied deeply into the conditions of certain departments, particularly those of water and sewers, and made practical and far-reaching recommendations. Much detailed information of value is given regarding costs of construction and maintenance, the relative merits of contract and day work are sanely discussed, and the effect of age and term of service upon the efficiency of day labor is shown by numerous tables. Although relating principally to conditions in the city of Boston, the report also presents for comparison tabulated facts regarding different cities throughout the country. This volume possesses unusual interest for municipal officials and engineers, for it reports the work of experienced experts in a way to at least suggest the applicability of the results and conclusions to other municipalities. Unfortunately, however, the edition authorized by the city is so limited that practically no copies will be available for general distribution.

Canadian Society of Civil Engineers' Annual Excursion will be reported next week.

## MARKET CONDITIONS.

Winnipeg, June 29th, 1909.

The country trade, taking the local market as a basis, is good, and the dealers report orders coming in for shelf and heavy hardware in a very satisfactory manner. This activity is accounted for by the large amount of building going on throughout the West. Fair orders are being obtained for wire nails and all lines of building paper, while the many items of builders specialties are active. Business has, if anything, strengthened up in the past week, as crop prospects are said to be the brightest in years, and money is in many cases looking for investment. Nothing definite, of course, is yet known as to the harvest, and country dealers will not place extensive orders until this is assured.

Local market quotations are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10½c.; anvil and vice combined, each, $5.50.

**Bar Iron.**—$2.50 to $2.60.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

**Bricks.**—$11, $12, $13, per M, three grades.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $8 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plaster's, 80 to 90 cents per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Pipe.**—Iron, black, per 100 feet. ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

**Picks.**—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

**Pitch.**—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

**Tool Steel.**—8½ to 15c. per pound.

**Timber.**—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Boards.**—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

* * * *

Toronto, July 1st, 1909.

The holiday coming in the middle of the week has had the effect of making the market very quiet. Brick are in steady demand, but it is expected the yards will be able to supply the demand within a week. Cement remains firm, the demand from Western Canada helping to steady the market.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market weak at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. The spring rush is over and business steady.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth, delivered, $18; at works, $17 per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Osbawa.

**Cement.**—The supply is far beyond the demand, and every maker seems to have his storage capacity occupied to the full. There is no reason, therefore, to look for any immediate change in the present quotation of $1.70 per barrel, including bags, or $1.30 without bags, car lots; for smaller quantities $1.40 to $1.50 per barrel in load lots delivered in town and bags extra. In paper packages, price would be, including paper bags, $1.40 to $1.50.

**Coal.**—Pennsylvania hard coal the retail price in Toronto is $6.50, with a strong likelihood of its continuing at this price for a month or two, the operators appearing to have agreed for a while. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The firmness continues at $13.85 to $14.05 per 100 lbs. The demand continues moderate.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR

**Editor**—E. A. JAMES, B.A. Sc.
**Business Manager**—JAMES J. SALMOND

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**NOTICE TO ADVERTISERS**

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TORONTO, CANADA, JULY 9, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## CANADA'S WATER POWER.

The water power of Canada is one of the most valuable assets, and when one considers that the probable available water power of Canada exceeds 25,000,000 horse-power one must be impressed with the possibilities of hydro-electric development in this country.

In a recent report on this question Mr. J. B. Challies, B.A.Sc., of the Department of the Interior, Ottawa, estimated the minimum flow development of all the water powers of Canada at 25,682,907 horse-power, and of this enormous amount only about a fiftieth has been developed, or some 516,885 horse-power. It has been estimated that the maintenance of one horse-power per annum from steam power requires 21.9 tons of coal. On this basis the Canadian water powers would develop annually as much energy as 562,455,033 tons of coal will give out in steam power.

The following table gives the distribution by Provinces of the power possibilities and of the present developments:—

| Location. | Minimum Flow Development. | Present Development. |
|---|---|---|
| Yukon | 470,000 | .... |
| British Columbia | 2,005,500 | 73,100 |
| Alberta | 1,144,000 | 1,330 |
| Saskatchewan | 500,000 | .... |
| Manitoba | 505,000 | 18,000 |
| North-West Territories | 600,000 | .... |
| Ontario | 3,129,168 | 331,157 |
| Quebec | 17,075,939 | 50,000 |
| New Brunswick | 150,000 | .... |
| Nova Scotia | 54,300 | 13,300 |
| Total | 25,682,907 | 516,887 |

The largest single water power is said to be on the Hamilton River, Labrador, where there are some nine million horse-power available.

With the solution of the problem of long distance transmission of electricity there will come a period of great activity in power plant erection.

Canadian water powers will in time be utilized for long distance haulage of freight and passengers. Electricity will be used for heat as well as for lighting, and the Department of the Interior did well in pointing out the location, distribution, and possibilities of Canada's water power.

## MR. LUMSDEN'S RESIGNATION.

The resignation of Hugh Lumsden, Chief Engineer of the National Transcontinental Railway Commission, again places this great public work, its management, and its staff of engineers in the limelight.

Mr. Lumsden has been chief engineer since the organization of the Transcontinental Commission five years ago. This great enterprise has grown under his direction, and he must be familiar with routine and details to such a degree that his resignation will be serious, indeed.

It is but natural that in work of such magnitude, covering such a stretch of country, there should arise

circumstances in which criticism would find room for expression. Add to the difficulties—engineering, financial, strategic, and politics—and you have a combination that will quickly breed scandal talk.

The reason for Mr. Lumsden's resignation has not been given. It is not a matter of holidays nor incapacity for hard work. Men of Mr. Lumsden's type do not quit work in the midst of difficulties. The motive for his resignation must be sought elsewhere.

Last winter Major Hodgins' charges were not fully considered. The Government and the contractors were pleased to see them dropped. Greater candor on the part of the Government at that time and a more thorough investigation at that time would have made unnecessary much of the work of the Arbitration Board.

The public have decided that Mr. Lumsden resigned because, from first to last, the politicians appointed and promoted more engineers than did the chief, and any fairy tales that may be invented will not satisfy.

The public are about right, and, Mr. Graham, if you are going to save the situation, you will require more resignations, and those from men around the top.

The C.P.R. furnished scandal talk for twenty years. The G.T.P. will do likewise unless some courage is shown in handling the present situation.

## THE ENGINEER AND HIS JOB.

The engineer who is most sought after is the one who asks as few questions as possible. Whether as an engineer taking charge of work for a client or as an engineer reporting to his chief, he will never favorably impress by fussing and volleys of questions.

Results are what are required, and no amount of talk or show will take its place. Your client or your chief does not want to be worried with unnecessary questions, nor does he want you to take undue responsibility.

The successful engineer is the man whose courage and good judgment will allow him to take the initiative, and who can be trusted to work out successfully the scheme and its details.

## THE ENGINEERS' CLUB, TORONTO, ANNUAL EXCURSION.

The Engineers' Club, Toronto, have arranged to hold their annual excursion this year on July 16th and 17th. The trip will be by C.P.R. train to Bobcaygeon, and from there on the following day the party will sail through the Kawartha Lakes and Canal to Lake Simcoe, returning by the York Radial Railway to Toronto.

Those who took the trip with the Club last year had a most enjoyable and profitable time, and it is expected this year the attendance will be even larger than on previous occasions. There is much to see, the trip is planned away from the usual path of sightseers, and those wishing to go should at once communicate with the treasurer, J. L. Street, 37 Melinda Street (M. 3280), so that travelling arrangements may be completed, and so the comfort of all provided for.

## EDITORIAL NOTES

The Dominion Iron and Steel Company made a new record in nearly all of its departments during the month of June. The products were as follows:—

| | Tons. |
|---|---|
| Pig iron | 24,260 |
| Steel | 28,142 |
| Rails | 18,419 |
| Wire rods | 7,404 |
| Total shipments | 27,000 |

The Canadian Pacific Railway Company's fiscal year closed June 30th. Gross earnings for the year were the greatest on record, being at least $76,117,167, compared with $71,384,173 last year. In June the gross earnings amounted to $6,354,000, but this figure will be considerably augmented by the miscellaneous receipts when the final reports are made up.

* * * *

The Interstate Commerce Commission have issued the railway accident returns for the first three months of 1909. The returns show that in the United States there were 663 people killed and 15,122 injured. This shows an increase in casualties of 344, but a decrease of 65 in deaths over the first three months of 1908. The damage to cars, engines and roadways by these accidents amounted to $1,847,202.

* * * *

The ratio of working expenses to traffic receipts on the French railways is increasing. On the Orleans system in 1905 the ratio was 46.70 per cent., in 1906 it was 48.29 per cent., and in 1908, 53.88 per cent. The increased price of material had something to do with this, but so also had the decision to grant each employee fifty-two holidays in the year. This alone cost this system $600,000.

## PRECIPITATION FOR JUNE, 1909.

The rainfall was very deficient in nearly all portions of the Dominion, except in a few isolated localities, noticeably in the Gaspe Peninsula, and in the extreme southwestern portion of Saskatchewan, where for the most part the usual quantity appears to have been well exceeded. Ottawa City recorded an amount in excess of the average, also a few places in the extreme southwestern counties of Ontario, in each instance owing to the prevalence of thunderstorms in the localities affected. In British Columbia the negative departure varied from six-tenths of an inch to three inches. In the Western Provinces, the deficit was very generally from 33 to over 100 per cent., in Ontario, from one and a quarter to two inches and a half, in Quebec, from three-fourths of an inch to over two inches, and in the Maritime Provinces from one-half to nearly three inches.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for the month.

| Station. | Depth in inches. | Departure from the average of twenty years. |
|---|---|---|
| Calgary, Alta. | 2.1 | —1.0 |
| Edmonton, Alta. | 1.8 | —1.3 |
| Swift Current, Sask. | 5.0 | +2.0 |
| Winnipeg, Man. | 1.5 | —2.0 |
| Port Stanley, Ont. | 2.8 | +0.0 |
| Toronto, Ont. | 1.2 | —1.5 |
| Parry Sound, Ont. | 1.1 | —1.6 |
| Ottawa, Ont. | 2.4 | +0.8 |
| Kingston, Ont. | 1.1 | —1.7 |
| Montreal, Que. | 1.6 | —2.1 |
| Quebec, Que. | 3.2 | —0.7 |
| Chatham, N.B. | 3.0 | —0.5 |
| Halifax, N.S. | 1.1 | —2.7 |
| Victoria, B.C. | 0.5 | —0.6 |
| Kamloops, B.C. | 0.8 | —0.6 |

## CANADIAN SOCIETY OF CIVIL ENGINEERS' ANNUAL EXCURSION.

This year the Canadian Society of Civil Engineers held their annual excursion on June 24th and 25th, to Windsor, Ont., and visited the Detroit tunnel and the Canadian Bridge Works, Walkerville.

Three coaches were required for the party, one coach from Montreal, one from Ottawa, and one from Toronto. A quick and pleasant trip was made by C.P.R., T.H. & B., and M.C.R.

At Windsor, Ont., the party were the guests of the Butler Bros.' Company, who have the contract for building the new tunnel under the Detroit River. A thorough inspection was made of the shield work at the approaches and the sub aqueous section where the work is being carried on under air pressure. A trip was made to the concreting barge in mid-stream, from which the concrete is poured around the iron pipe.

On the second day the Canadian Bridge Works at Walkerville was inspected.

Among the party from Montreal was:—A. Belanger, J. T Bertrand, W. I. Bishop, W. E. Boucher, J. L. Busfield, P. Davis, J. A. DeCew, J. A. Jamieson, T. Lanctot, J. G. Legrand, T. W. Lesage, H. M. MacKay, A. McCulloch, C. M. McKergow, C. H. McLeod, M. Morssen, S. F. Rutherford, T. G. Randolph, F. P. Shearwood, J. H. Sullivan, W. V. Taylor, W. F. Tye.

From Toronto:—A. C. D. Blanchard, L. O. Clarke, S. J. Fisher, J. Galbraith, E. A. James, E. B. Jost, E. H. Keating, K. A. MacKenzie, N. M. McLeod, F. F. Miller, W. Miller, C. W. Noble, W. F. Scott, C. R. Young.

From Ottawa:—A. Amos, N. Cauchon, C. R. Coutlee, A. S. Cram, F. Davis, H. M. Davy, R. F. Davy, G. A. Mountain, J. J. Murphy, A. Roger, A. Surveyer, G. Volckman, E. T. Wilkie.

From St. Thomas:—J. A. Bell, F. A. Bell, G. A. McCubb'n.

## AIR COMPRESSION.

On the evening of July 5th, at the Engineers' Club, Toronto, Mr. William Reavell, M. Inst., M.E., of Ipswich, Eng., gave an address on the Principals Governing the Compression of Air.

Mr. E. Wragge, Consulting Engineer, Toronto, acted as chairman, and the audience listened with great interest to Mr. Reavell's address.

Mr. Reavell described the design and workings of one, two, or three stage compressors, as well as unjacketed compressors, he also outlined the various methods of testing the efficiency of compressors. He also took up the question of the relative efficiency of turbo and reciprocating machines, and said in part:—"The difficulty of making exact tests, and the difference of opinion which exists as to the proper way in which efficiency should be measured, account for much of the confusion by which the subject is surrounded. If the heat generated during compression could be continuously extracted, so that compression was isothermal, the work done would be a minimum, and the efficiency, consequently, the highest possible. Isothermal compression is quite impossible of realization, though the ideal forms a convenient basis for comparison. On the other hand, one may assume no heat abstracted, and compute efficiency, therefore, on the basis of an adiabatic compression. This is in a sense fairer to the machine, but not so good a guide to the purchaser, particularly if he wants to use his air cold. A third method is that used by Professor Rateau, by which, in the absence of water-cooling, the efficiency is deduced from the temperature rise of the air in passing through the machine."

## PERSONAL.

MR. LAWFORD GRANT has been appointed manager for Canada of the Canadian British Insulated Company, Ltd., Montreal, Canada, who have bought out the Canadian interests of the British Insulated and Helsby Cables, Ltd.

MR. FRANK W. MORSE, former General Manager of the Grand Trunk Pacific Railway, is in Montreal. Mr. Morse came from New York on the G.T.R. private car by which Mr. C. M. Hays went to New York en route to England.

## WATER STORAGE IN ELEVATED TANKS AND STANDPIPES.*

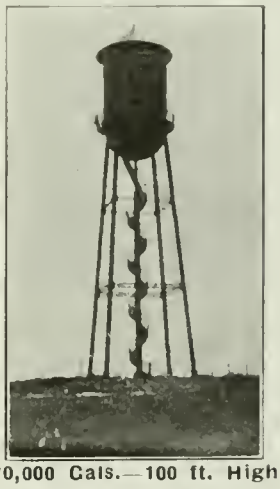
H. E. Horton, M.W.S.E.

The advantage of water stored at an elevation is recognized by all as desirable; to fit to the varying local conditions many expedients are resorted to. We have under discussion the use and advantage of the elevated tank and standpipe.

It may be interesting to notice the evolution from the wood tank on a low trestle, as so universally used for water supply to the railway locomotives, placed upon a higher trestle for a small town's water supply, this trestle as time went on being substituted by metal, and following this the tank being made of steel; all in the same line of evolution and about the same time that bridges and cars changed from wood to steel.

Occasionally there is suggestion of building elevated water storage in reinforced concrete. However, as it takes the same amount of steel to reinforce the concrete that it does to hold the water without the concrete, it has only been used where there is an apparent intensity of desire for the truly unique, and for the purpose of this discussion we will ignore it.

A standpipe, open at the top, of small diameter, was an attachment to large pumping works at a very early date



70,000 Gals.—100 ft. High.
Highland Park, Dallas, Tex.

70,000 Gals.—220 ft. High.
Rutland, Vt.

to relieve the water hammer on the pumps. We have in Chicago the water tower at "Chicago Avenue" and "Ashland Avenue" Pumping Stations as examples.

Mr. Cook, of Toledo, Ohio, some forty years ago was, I believe, the originator of a system of waterworks for small towns wherein, with a moderate sized pumping engine, the standpipe was materially enlarged, thereby providing storage under pressure (the advantage being the relief from continuous pumping), and the standpipe came into very general use for such locations as fitted for—a level town or small city.

The term, standpipe, as here used, defines a class of structure, say, 10 ft. to 30 ft. in diameter, with heights equal to 3 to 12 diameters. Such a structure has its limitations as to economy of construction.

The largest examples of metal tanks (not known as standpipes), to hold water that have come under my notice are those for making the water seal of gas holders, where tanks of some 200 ft. in diameter and 50 ft. high have been used and as stresses in the shell = radius × water pressure —it follows that in all tanks or standpipes the stress in the unit of the material is as the height multiplied by the diameter; hence, a tank 40 ft. in diameter and 250 ft. high would have the same stress in the material as for the one indicated above, and would be something over 25,000 pounds per inch vertical near the bottom of such tank, and material

* Read before the Western Society of Engineers.

must be provided for normal unit stresses of over 2 in. in thickness.

Now, as it happens that water stored for purposes like fire protection in its various demands, such as sprinkler system for fire extinguishment for regular town waterworks, water is frequently required at considerable elevation and with the least range of varying pressure; in fact, an absolute uniform pressure would be ideal. This is impracticable; hence, we must allow at least 10 per cent. of the extreme height for a varying pressure.

From estimates covering a large number of examples, with limitations as above, it may be asserted that with a low elevation like a mere flat tank, a tower is at a disadvantage, but when the average elevation of water required is 100 ft. it will cost twice as much to store it in a standpipe as in an elevated tank. Again, it may be wanted at an average elevation of 150 ft.; if so, it will cost three times as much to store it in a standpipe as in an elevated tank. When wanted at 200 ft. average elevation it will cost four times as much to use a standpipe as the tower and tank. At 250 ft. average elevation it will cost five times as much in a standpipe as in a tower and tank. At 300 ft. average elevation it will cost six times as much to use the standpipe design as a tank. From all the above, it is apparent why towers and tanks have come into use for storage of water where potential energy of the water is a matter of consideration.

The tower to support a tank may be readily designed with three or more supporting legs. The foundations for such tower and the stresses from wind are well worked out in connection with the elevated skeleton structures so frequently seen on our railroads. Local conditions must determine the character of the foundations. The batter of the legs will usually be such that the uplift from the wind on the windward side (and tank empty) is abundantly provided for by convenient anchorage. It will be found an advantage to place the legs of such a tower radially from the centre, so all the legs will be alike for convenience in manufacturing.

The tank itself may be a cylinder with a flat bottom placed upon a platform built of beams. This class of design will invariably be over costly, the relation varying somewhat as the diameter to height of tank varies. Preferably the bottom may be conical or hemispherical, made of plates only; in fact, combinations of the spherical combined with the conical have been worked out to relieve the excessive stresses developed at the intersection of the cone and cylinder. It is somewhat the personal equation of the designer that determines how this part of the design shall be carried out.

At the point of attaching the tower to a tank it is quite the usual practice to use a horizontal girder strong enough to take up any tendency to deform the cylinder by the horizontal components of the supporting posts; hence, it will be observed that this girder is of much greater importance on a tank supported with three posts than if the same tank was supported by six.

From conditions as herein indicated there has been much discussion and variation in design in placing a tank with a conical or spherical bottom on a tower. Many designers believing it is a necessity to extend the cylindrical part some distance below the water level, and look at, and think of, this extension as a circular girder, while others have treated the entire depth of the cylinder of the tank as the web of a circular girder. Sufficient to say that there is no difficulty in making an efficient design either way.

Some engineers feel a greater satisfaction in designs so developed as to present a multiple number of supports from the tower to the tank, which to all of this there is no objection other than the one of increased cost. The best results with least cost will always be found with a standard design.

The tank must hold water. Tight work has to be developed. It will ordinarily be found to great advantage in construction if a close study is made of the joints and their disposition to the end that rivets will not necessarily go through a large number of plates, and that caulking edges be so arranged that the same may be gotten at to caulk and make the work watertight.

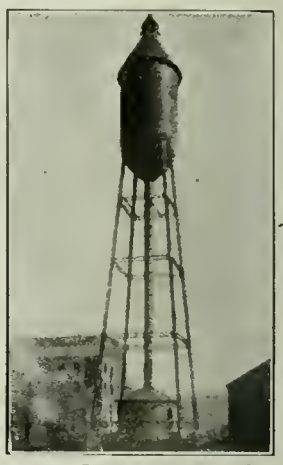
The tank on such towers is usually supplied with water by a riser pipe up the centre of the tower. This riser pipe is enclosed in a frost casing, some three or more thicknesses of lumber, about which "building felt" is freely used.

For sprinkler tanks, where water merely stands in the tank, in this climate they will have to be supplied with artificial heat. This may be accomplished by a moderate-sized water heater directly connected with the riser pipe, or with live steam, if the tower is so situated that live steam is available.

If the tank is in general service, like a town's waterworks, and the service is such as to require, say, one hour's pumping in the morning and one hour in the evening, a very moderate-sized works will require no further attention as to freezing.

I do not wish to be understood as advocating the use of an elevated tower and tank in connection, say, with a hill, to put an ordinary earth reservoir in, or to place a flat metal tank on, provided said hill is within convenient reach from both the pumping station and the point of consumption. Each location presents a problem

**50,000 and 75,000 Gals.—71 ft. and 130 ft. High. Factory Power Co., Cincinnati, O.**



**112,000 Gals.—162 ft. High. Lackawana Steel Co. Buffalo, N.Y.**

When not favored with a convenient natural elevation, the elevated tank offers to average communities, water storage, so that the pumping plant requires to be in actual operation only some small portion of each twenty-four hours, and one force of operators can maintain the works, thus making it possible for many small towns to maintain and operate waterworks that otherwise could not because of the operating costs.

Examples without number have come under my observation of the reduced expenses where a tower and tank has been installed, where work has previously been done by direct pressure from the pumps. In the city of Chicago, at the Washington Heights Pumping Station, while the full force of men have been maintained, the quantity of coal was reduced approximately one-third upon the installation of the elevated tank.

At Paris, Ill., the city had operated a direct pressure pumping plant for twenty years, and with a double set of operators, when in 1895 an elevated tank was attached to the system with the result that at once one set of operators was sufficient to continue the work; in fact, the entire cost of operation was reduced 40 per cent.

At Galion, Ohio, a franchise company, after running the pumps for direct pressure for twenty-five years, introduced an elevated tank, and the cost of their operations was reduced one-third, with a much more satisfactory and uniform pressure for the town. The list of instances of advantage as here indicated could be extended almost without limit.

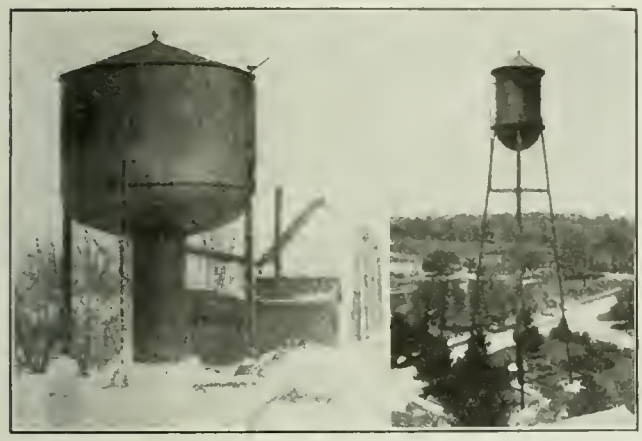
Of the standpipes built in other years a number of somewhat startling failures have occurred. Reviews have been

made of the structures that failed, and it seems to be noticeable that there were fairly high unit stresses involved in all cases.

In years past little attention seemingly has been given by designers of standpipes to the efficiency of the rivet connections. In analyzing this question of efficiency of connections we assume that rivet shear is equal to two-thirds the tension value of the material, and it is not unusual to find standpipes with rivet efficiency of no more than 30 per cent. of the value of the plates.

The question of rivet efficiency in anything like boiler or tank work is of paramount importance. While it is possible by double butt strap joints to make a rivet joint of more than 90 per cent. efficiency, yet due to the added weight of material as well as cost of labor, it may be doubted if there is any advantage in attempting to develop efficiency to exceed 80 per cent. In fact, in moderate-sized tanks something like 70 per cent. efficiency will quite likely work out the most satisfactory. Experience seems to justify the use of lap joints on material up to, say, ½-inch thickness.

There never has been a failure where the stresses on the efficiency of the joints in the standpipe were as low as 15,000 pounds per square inch, and larger numbers of pipes are standing and have stood for a long period of years where the stress on the efficiency of the joints is over 30,000 pounds per square inch.



**60,000 Cals.—35 ft. High. C.P. & St. Louis Ry., Lock Haven, Ill.**

**100,000 Cals.—150 ft. High. Hospital for Insane, Columbus, O.**

The group of standpipes referred to above were designed on a basis of gravity stress of about 15,000 pounds per square inch of the gross section of the plates. That the mortality has not been more serious is surely a kind interposition of an over-ruling Providence. While there may have been bad material and bad workmanship, there has also been most unfortunate designing. To such designs the failures must be charged.

Towers and tanks have a better record as to their mortality. In fact, very little in the way of failure or criticism has presented itself. There have been examples of conical bottoms attached to the cylindrical part with a moment on the joint. Great difficulty has been experienced in keeping such joints tight, and the one only very considerable failure of a tower and tank has occurred from this fault in design.

It is my pleasure to present to you some illustrations of sundry examples of elevated towers as constructed. These have been selected as showing a variety of use, as also a variety of structures.

We have the tower and tank, with sundry expressions of architectural effort and atmosphere, all of which reminds us that the personal must have consideration, and the further very interesting fact that there is no gauge in the matter of taste.

We have a tank with elaborate protection against the cold in the extreme north. We have them with no protection in the south.

The towers and tanks shown are in use for

City Water Works.
Public Institutions.
Private Estates.
Industries.
Railroads.
Hydraulic Works.

With examples of

Three supports to tank.
Four supports to tank.
Six supports to tank.
Eight supports to tank.
Twelve supports to tank.

Also the

Flat bottom tank.
Conical bottom tank.
Hemispherical bottom tank.
Semi-elliptical bottom tank.

We also have a lantern slide showing a 50-foot diameter tank bottom, fully assembled in the yard for reaming 15,000 radial holes through approximately 1⅞-in. from 11-16-inch to 1 1-16-inch.

**125,000 Cals.—135 ft. High. C.P.R., Winnipeg, Man.**

**75,000 Cals.—91 ft. High. Edmonton, Alta., N.W.T.**

In the matter of spherical work, the surface cannot be developed, while the cylinder or cone may be. The difficulties of mechanical execution are such as to generally preclude the use of the sphere or sections thereof in plate metal construction.

The amount of water pumped for Erie, Pa., during 1908 was 4,483,392,032 gallons, an increase of 157,205,184 gallons over 1907. The average daily pumpage was 12,249,705 gallons, or a per capita of 175 gallons on a basis of 70,000 population. The amount of water furnished by meter measurement to manufacturers and other large consumers was 1,169,530,621 gallons, a decrease of 27,590,994 gallons from the previous year. Deducting the amount of water furnished by meter measurement from the total amount of water pumped, gives the approximate amount of water furnished for domestic use, churches, schools, charitable purposes, fire protection and other city uses, 3,313,855,441 gallons, a daily average of 9,054,249 gallons, and an average daily consumption for the several uses mentioned of 129.35 gallons, being an increase in the daily per capita of 2.35 gallons.

The Canadian Pacific Railway Company's fiscal year closed last Thursday, and the new year started on Friday morning. Gross earnings for the year ending June 30th, 1909, were the greatest on record, being at least $76,117,167, compared with $71,384,173 last year. In June the gross earnings amounted to $6,354,000, but this figure will be considerably augmented by the miscellaneous receipts when the final reports are made up. Steamship earnings will be added to the above figures in the final report.

## ENGINEERING ORGANIZATION.

R. E. W. Hagarty, B.A.Sc.

As a conclusion to "Hydraulic Engineering in the Yukon," an article which appeared in The Canadian Engineer, February 19th, 1909, a few words regarding the organization features of the Yukon Gold Company are probably in order.

The importance of organization in a large engineering work is evident; but, nevertheless, we are sometimes surprised to find clever engineers either naturally or affectedly deficient in regard to this feature. There are others who will frankly admit the importance of thorough organization, but who trust such matters to a walking boss, or a foreman. For instance, the management of the Panama Canal under the old regime was an example of this condition.

However, after examining the working conditions which existed in the Yukon construction one realizes not only the importance of organization, but that the effective application of the same is a science which must play a large part in any successful engineering undertaking.

The fact that the Yukon is widely remote from the outside world, and also the shortness of the working season rendered complete organization designed for rapid construction doubly necessary.

At the head of affairs was a man who ranked as chief engineer, organizer and business manager combined. He was virtually "czar" of the entire concern and was personally responsible for all details in every department. His position was known as that of "resident manager" Under him were the heads of the various departments, of which the following is a classification:—

I. Construction Department:
  (a) Main ditch (excavation),
  (b) Pipe line,
  (c) Flume.
II. Hydraulic Department.
III. Dredging Department.
IV. Surveying Department.
V. Electric Department.
VI. Business and Legal Department:
  (a) Legal,
  (b) Accountants',
  (c) General book-keeping,
  (d) Time-keeping and employment,
  (e) Commissaria.,
  (f) Warehouse, ordering and shipping,
  (g) Cost department (distribution, book-keeping).

The heads of each department reported directly to the Resident Manager, who was thus kept in constant possession of the details of the entire system to an extent impossible under other conditions.

Under these circumstances, however, the heads of departments have practically independent control over their respective sections of the work; and this frequently caused trouble to the resident engineers, or the foremen who had work within the jurisdiction of more than one of the department superintendents each of whom was apt to expect his own portion given precedence.

Considering the enormous difficulties of construction and the extent of the work the organization proved a practical success and reflects considerable credit upon Mr. O. B. Perry, Mr. C. A. Thomas, and others in charge of the work.

## SOME PRODUCER GAS PLANTS IN AND AROUND THE CITY OF BERLIN, GERMANY.*

B. F. Haanel, B.Sc.

Five gas producer plants were visited; four of which were situated in Berlin and vicinity. Of the four inspected in Berlin, and vicinity, two were equipped with anthracite producers; one with a coke producer; and one with a lignite (brown coal) briquet producer. The fifth was installed at the plant of the Körting Brothers at Hanover, and was equipped with a producer for gasifying badly caking bituminous coal.

### Coke Producer Gas Plant.

This plant is situated at Wilmersdorf, a suburb of Berlin, and is used for pumping water for city purposes.

The equipment consists of four 400 horse-power two-cycle, Körting gas engines—using either producer or illuminating gas—and two large coke gas producers. Under ordinary circumstances coke would never be used whenever cheaper fuel is available, inasmuch as its cost is prohibitive. In this case, however, the municipality operating this pump station also operates an illuminating gas plant, the coke from which is used to generate gas for the pumping engines.

This plant has been operated continuously for several years, and the cost of repairs and up-keep is said to be extremely low; much below that for a steam plant of like capacity, used for a similar purpose.

It may be of interest to note that, the number of revolutions of the engine varies according to the work done; from 30-90—the efficiency of the engine remaining constant.

The consumption of coke per effective horse-power hour is 1.5 kg. (3.3 lbs.), which seems excessive, and as it costs at Wilmersdorf from 30 to 40 marks ($7.20 to $9.60 per ton), coke—especially at this place—cannot be called an economical fuel.

### Anthracite Producer.

A plant, consisting of three gas engines of 110 effective horse-power each, and three anthracite gas producers, was installed in the basement of the warehouse of A. Yandorf and Company, Berlin. The power developed was used for generating electricity for light and power purposes.

This plant has been in operation for four years, and employs a chief engineer, one assistant engineer and one stoker. The cost of repairs during the four years it has been running is said to be very low.

The consumption of fuel per effective horse-power hour is 0.38 kg. (0.836 lbs.), which is very satisfactory, the builders in this case guaranteeing one lb. per horse-power hour.

No trouble at all is experienced from any source with these producers, and the labor of stoking and cleaning of ashes is almost negligible.

*Extraction from a report to Hon. W. Templeman, Minister of Mines for Canada.

## RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of June 28 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price July 2 '08 | Price June 24 '09 | Price July 1 '09 | Sales Week End'd July 1 | Price July 2 '08 | Price June 24 '09 | Price July 1 '09 | Sales Week End'd July 1 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,971,000 | 1,777,000 | 158½ | 181½ | 183 | 110 | 160 | 159 | 182½ 182½ | 182 | 470 |
| Canadian Northern Railway | 2,986.9 | ... | ... | 260,600 | 218,700 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 1,195,366 | 1,181,808 | ..... | *1st. pref. 105½, 3rd pref. 56½, ordinary 23¾ | | | ..... | | | | ..... |
| T. & N. O. | 334 | (Gov. Road) | ... | 34,957 | 21,873 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 78,113 | 74,128 | ..... | ..... | ..... | ..... | 173 | 172 218 | 217½ 218½ | 218 | 232 |
| Toronto Street Railway | 114 | 8,000 | 100 | 79,868 | 71,584 | ..... | 123½ | 123¾ | 2 | 98½ | 98 124 | 123½ 124 | 123¾ | 215 |
| Winnipeg Electric | 70 | 6,000 | 100 | ... | ... | 157 | 185 | 187½ | 186 | 96 | 159 | 158 ... | ..... | 20 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

An interesting feature of this installation is the arrangement of the charging hoppers of the producers. As described above, the producers are situated in the basement of the building, and the roof of that part containing the producers is level with the ground above, and constitutes the driveway for trucks, etc. The charging hoppers of the battery of producers project through this roof into this open court or driveway, and the fuel is simply hauled beside the charging hoppers and dumped into the coal boxes contiguous to them.

By this method, the cost of stoking—in addition to being accomplished in the open air—is reduced to a minimum.

The waste gases of the engine exhaust—which are a nuisance in most gas engine plants, owing to the odor and noise—are in this plant discharged at the top of the building, which is four stories high.

The cost of fuel delivered is 19 marks ($4.56) per metric ton. A metric ton corresponds to the English long ton, from which it will readily be seen that the plant is very economical.

The second anthracite gas producer plant visited was that of the Spindlershof Geschaftshaus, Berlin.

This installation is composed of two engines of 110 horse-power, running at 160 revolutions per minute—used for lighting; and one engine 180 horse-power, 140 revolutions per minute, used for power purposes. The anthracite gas producers in this plant are identical with those employed in that described above. The engines and producers have been in constant use for six years, during which time no troubles of any kind have been experienced, and during this period the cost of repairs was remarkably low.

The average consumption of fuel per effective horse-power is 0.4 kg., about 0.88 lbs. The price of coal delivered at this plant is about 19 marks ($4.56).

### Caking Bituminous Coal Producer.

The only producer gasifying caking bituminous coal inspected was at the workshops of the Körting Brothers, Hanover, and was utilized as part of the permanent power installation, for generating electricity. This producer is of 150 horse-power capacity, and has been run for a period of six weeks—twelve hours per day—without closing down. The only reason for terminating the run at the end of that period was, an accident to the electric generator. During the entire length of the run, no trouble of any sort was encountered, scarcely any poking of the fuel bed was resorted to, and the gas delivered to the engines was of a uniform quality. While no trouble was experienced in the running of the gas engines on account of tarry matter, an inspection after closing down disclosed the fact that, about 3 mm. of tar and soot were deposited on the walls of the cylinder, and in the entry and exhaust pipes.

The fuel consumption during the run was about one lb. per effective horse-power hour.

The smallest producer which the Körting Brothers guarantee to operate successfully on caking bituminous coal, is of 150 horse-power capacity; any smaller generator will not operate for any length of time, owing to the fusing of the

## A UNIQUE GASOLINE ENGINE TESTING PLANT.

**By Frank C. Perkins.**

The accompanying illustration shows a most complete and thoroughly up-to-date testing room as utilized at, Detroit, Michigan, for testing Gray gasoline engines which are run under conditions as near like those in service as possible.

The engines are run in such a way that every possible thing that might be a defect or cause of difficulty at a later date in the hands of a customer, is observed and corrected.

The illustration shows in this testing room eight blocks, or large testing stands, each of which holds two motors. In the centre of the testing stand is a water-cooled brake wheel, and between this wheel and the motor on each end is a friction clutch.

It is stated that this arrangement is to enable each engine under its own power to work out an engine which has just been brought from the testing room, and after an engine has been run under its own power for several hours or long enough to satisfy the inspector and chief tester that it is entirely satisfactory—a final brake test is taken from the water-cooled brake wheel.

It is interesting to note the method of testing employed. The engines are placed on a stand and the first engine is started under its own power and the friction clutch, driving the brake, is thrown in after which the second friction clutch is thrown in, which causes the first engine to drive a second engine.

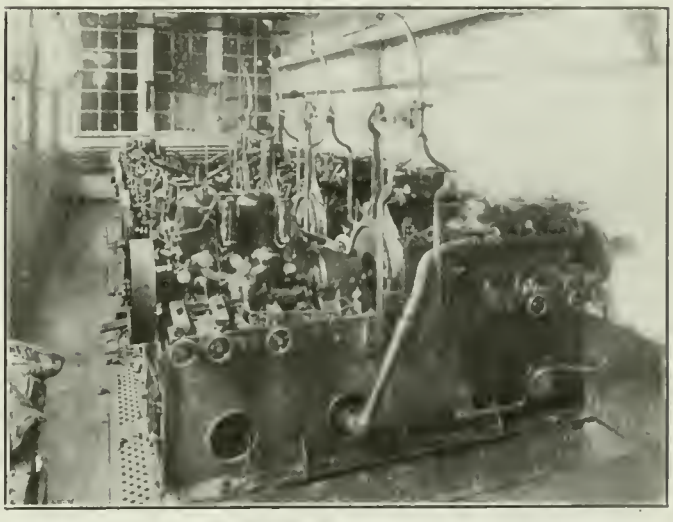
Sufficient load above the drag of the second engine is then added by tightening up the brake to absorb the full power of the engine at its normal speed.

The two engines, one driving and the other driven, are run in this manner for several hours, or until every detail of the outfit has been thoroughly tested and adjusted. A careful brake test on the first engine is then made, full data of which are recorded on a test card.

This engine is then removed and sent to finishing department to be prepared for shipment, and in its place is put the third engine and the second engine is then started up under its own power, driving the third engine, and this method is followed out continuously.

It is claimed that all moving parts are worked to a perfect contact before working strains are applied, and then when the motor is run under its two-power it is always given a load.

It is maintained that the fault with the testing out of



many motors is that they are run without a load and the brake test is taken from the fly-wheel; the fly-wheel soon heats and expands and requires frequent adjustment of the brake band, and practically makes it impossible to take a long test, but by using a water-cooled brake wheel the test can be given for as long as desired.

It will be noted that the beam of the brake is connected to a dynamometer and all engine power records are carefully taken at a certain speed, registered by a tachometer.

The careful testing of all up-to-date apparatus in engineering practice is now acknowledged to be invaluable, as in the end the added cost and trouble of this work is repaid to the manufacturer as well as the consumer many times over.

## STATEMENT OF ACCIDENTS DURING MAY, 1909.

| Trade or Industry. | Killed. | Injured. | Total. |
|---|---|---|---|
| Lumbering | 27 | 19 | 46 |
| Mining | 10 | 3 | 13 |
| Building Trades | 2 | 32 | 34 |
| Metal trades | 3 | 27 | 30 |
| Railway service | 23 | 19 | 42 |
| Navigation | 6 | 13 | 19 |
| General transport | 3 | 18 | 21 |
| Civic employees | 1 | 4 | 5 |
| Miscellaneous | . | 7 | 7 |
| Unskilled labor | 1 | 6 | 7 |

## SEPTIC TANK CONFERENCE.

On July 7th representatives of several Ontario municipalities, including London, Guelph, Waterloo, Berlin, Woodstock, St. Thomas, Peterborough, Preston and Barrie, met at the Engineers' Club, Toronto. After discussing the present situation and the probability of legal action being taken a deputation headed by Mayor Steveley and Mr. T. G. Meredith, K.C., of London, and Dr. Mearns, of Woodstock, waited upon Sir James Whitney.

They pointed out that in accordance with the directions of the Provincial Board of Health, they were installing systems calculated to purify sewage, and had been threatened with action for infringement of patent by the Cameron Septic Tank Company. They asked the Government to secure a competent opinion from Dr. Amyot and a patent attorney as to their rights.

"The request is a reasonable one," was the Premier's encouraging comment. "The Government will probably be able to give you an answer after its meeting on Thursday."

## THE SUCTION GAS PRODUCER FOR SMALL POWER PLANTS.

(Continued from Page 43.)

through which air and the water to form the steam was allowed to flow. These chambers are encased in a steel shell through which the exhaust from the engine circulates. This type of producer has been very successful in this country, and a large number of them are still being installed. This satisfaction is entirely due to the water regulator, which is so arranged as to vary the amount of water in proportion to the load. This water regulator is situated immediately on top of the vaporizer, and is controlled by the suction of the engine. An objection to this arrangement in my mind is that no steam is generated until after the engine has been working sufficient time to heat up the vaporizer and its connecting pipes.

One of the first producers that I built in this country and one that gave exceptionally good results is shown on the screen. A feature of this producer was that surrounding the generator proper there is a jacket in which the air to support combustion is pre-heated before it passes through the vaporizer, which is situated upon the pipe conducting the hot gases away from the producer. By this means I secured nearly enough heat to vaporize all the water fed. This identical producer was tested by Prof. MacFarland, of the Armour Institute, and although it was of only 16 horse-power he secured a fuel consumption of 1.02 of a pound of coal per B.H.P., which result I do not think is being bettered even at the present day on such a small size plant as 16 horse-power. I abandoned this design for the reason that steam was not generated sufficient to give a maximum value of the gas.

I next put on the market a producer in which I pre-heated the ingoing air by means of a jacket surrounding the pipe conducting the gas away from the generator, which hot air passes into the ash pit, the necessary steam being generated in an annular ring surrounding the boss. This plant gives a rich gas immediately upon the start, but requires more or less continual attention, due to the ashes accumulating at the base of the fuel column, so preventing enough heat from reaching the vaporizing ring. Another objection that developed was that if the plant was worked on a light load for any length of time the water fed to the vaporizer was immediately flashed into steam and passed up through the fuel column unequally, that is to say, that in the same vertical plane as the water admission pipe there would be plenty of steam, while on the side farther from the water pipe there was nearly an absence of steam. This caused clinkers to form at this side. Lately I have developed a plant in which I have combined the good features of my previous plants and at the same time overcome their objections. In this producer I use a double shell, the space between which I utilize to vaporize and superheat the air and resulting steam to 500 degrees F., the mixture becoming thoroughly mixed before it reaches the bottom of the annular chamber and it is admitted equally all over the base of the fuel column, thus preventing clinker formation. The vaporizer in this producer consists of an iron spiral surrounding the inner shell and is supplied with a measured quantity of water at or near the same place where the air to support combustion is admitted. The method of regulating this water is extremely simple.

This apparatus consists of two tanks of equal capacity, mounted upon a rocking table, which is balanced by means of a spring or pendulum. These tanks are partially filled with a liquid and are connected at the bottom by means of a pipe. One of these tanks is connected by means of flexible connection to the gas pipe supplying gas to the engine. As the demand for gas varies the liquid with which these tanks are filled flows from the one to the other, so upsetting the balance of the table and causing it to assume a new position, which position governs the effective opening supplying water to the vaporizer. It is necessary that suction producers be fitted with a charging device for the admission of fresh fuel while the plant is in operation; we use the regular bell type of hopper, which has given satisfaction for a number of years, but we have gone a step farther in so arranging it that it is impossible to open the top cover while the valve at the bottom is open, or open the valve at the bottom while the cover is open. These plants occupy a very small floor space and are so arranged that all parts can be gotten at for purposes of inspection or cleaning.

In an installation of a 100 horse-power plant which is operating 24 hours per day there is a fuel consumption of ¾-pound of coal per B.H.P. per hour.

## ASSOCIATION FOR THE DEFENCE OF SEPTIC PROCESS SUITS.

In his address before the Canadian engineers interested in the Septic Process of Sewage Purification, Mr. Wyllie, of Chicago, mentioned the Association for the Defence of Septic Process Suits in the United States. This association has for its objects:—

To aid the village of Saratoga Springs in determining the measure of damages due the company for the use of the septic process (the courts having already affirmed infringement); to defend any suits for royalties brought against any members of the association; to resist efforts to secure an extension of the life of the Cameron patent (which expires this year); to collect data as a basis for giving advice to members which will enable them to so operate tanks as to avoid infringement. Finally, to assist members in the adjustment of damages where infringement is affirmed by the courts.

The members are divided into three classes: municipalities, private companies or individuals owning or operating septic tanks, and individuals not owning or operating septic tanks. The last class is not subject to assessment, but the first two are to be assessed when necessary, according to a schedule. These assessments are intended to cover the cost of defending suits from time to time as such suits are brought, and for resisting the extension of the patent.

The officers of the association are: President, F. Herbert Snow, Chief Engineer, State Health Department of Pennsylvania; the secretary and treasurer, Geo. A. Johnson, of New York City; Executive Committee, Messrs. Johnson and Snow and seven other engineers, including H. M. Herbert, Chief Engineer of the New Jersey State Board of Health, and R. Winthrop Pratt, Chief Engineer of the Ohio State Board of Health; Patent Committee, George W. Fuller, of the firm of Hering & Fuller, who is also the consulting engineer of the association. The Executive Counsel is George W. Rightmire, of Columbus, O., and Charles L. Sturtevant, of Washington, D.C., is the consulting counsel.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEPTIC PROCESS PATENTS.

Septic process suits have been carried on in the United States for years and from court to court. The Cameron Septic Tank Company secured a decision in their favor, and since then many American municipalities and individuals have paid them royalties.

Many engineers throughout the United States do not approve of paying royalties on this process, and have organized an association for the defence of septic process suits. Particulars of the organization are given elsewhere.

In Canada the question of patentability has not yet been tested, but the present agitation may end in a test case being submitted. If such is done, it is to be hoped the question will receive careful consideration, so that when a decision is arrived at all parties to the dispute will be content with the finding, and then no attempt at evasions or impositions will be made.

## MONTREAL WATER SUPPLY.

The city of Montreal has had considerable trouble with their water supply, but through it all there has been so much secrecy that the uncertainty is just as trying as the actual conditions. Certain of the citizens have decided it is in the public interest that more information be given out in connection with the water supply. With this object in view they have presented the following petition to the city council:—

> Whereas, none of these reports have been published, nor the general public been made acquainted with the contents of these various reports; and
>
> Whereas, the city is about to expend a large sum of money (said to be $5,000,000) to acquire the Montreal Water and Power Company.
>
> Resolved, that it is, in our opinion, most important to determine, by expert analysis, before purchase, if such water is a safe and wholesome supply.
>
> Resolved, that we, the undersigned, citizens of Montreal, request that the various reports on the water supply be published, so that the public may be made aware of the findings of these experts and the recommendations made in their reports.

It is to be hoped that the city council will grant the request, and that other municipalities will see the wisdom of placing such information within easy access of those interested.

## SEPTIC ACTION AND WATERBURY SEWAGE.

That the ways of septic action are at times somewhat peculiar is amply demonstrated by a comprehensive study of the characterists of the Waterbury (U.S.) sewage in this connection.

For a period of eighteen months beginning July, 1905, a study has been made of this sewage in relation to its behaviour under septic conditions and other forms of preliminary treatment for removal of solids.

The deductive studies have been carried out under the Board of Public Works, Mr. R. A. Cairns, M. Am. Soc. C.E., city engineer; Mr. Wm. Gavin Taylor, M. Am. Soc. C.E., resident engineer, and Mr. Harry B. Hommon as chemist. Although two years have elapsed since the completion of the experiments, they have just found publication by Mr. Taylor in the Engineering News.

The crude sewage was of medium strength, substantially free from refractory trade wastes, and was alkaline in character. It was delivered at the screen chambers practically fresh, the organic matters being in large pieces. The composition of the sewage is shown by averaging the chemical analyses of 314 daily composite samples, consisting of 15,072 half-hourly portions, as per following table.

Average chemical composition of Waterbury sewage November 1905 to November 1906:—

| Parts Per One Million. | |
|---|---|
| Temperature degees F. | 58.0 |
| Oxygen consumed, total | 46.0 |
| Oxygen consumed, dissolved | 26.0 |
| Oxygen consumed, suspended | 20.0 |
| Organic nitrogen, total | 14.8 |
| Organic nitrogen, dissolved | 10.3 |
| Organic nitrogen, suspended | 4.5 |
| Free ammonia | 7.8 |
| Nitrites | .14 |
| Nitrates | 1.52 |
| Chlorine | 48.0 |
| Suspended matter, total | 165.0 |
| Suspended matter, volatile | 115.0 |
| Suspended matter, fixed | 50.0 |
| Dissolved oxygen | 3.8 |
| Free $CO_2$ | 18.0 |
| Alkalinity as CA $CO_3$ | 26.0 |
| Fats (other soluble matter) | 26.0 |

Septic action of the crude sewage was studied for the purpose of determining the value of such treatment in preparing the sewage for filtration through sand and sprinkling filters and for its purification by means of contact beds.

Two tanks were used in the tests for septicization, each being 14 ft. long by 6 ft. 3 ins. wide by 6 ft. deep and containing about 4,000 gallons. A third and similar tank was operated as a plain sedimentation tank for a comparison. Flow periods through these tanks ranged from 8 to 33 hours.

Tests were made upon the tanks to prove the uniformity of flow, by noting the passage of colored sewage and by a close comparison of analyses just before and after the interposition of an extensive baffling system in tank 2, with the result that no marked irregularity or non-uniformity of the flow could be detected. The actual flow rate within each tank was in substantial accord with the calculated flow period.

From September 3rd, 1905, to November, 1906, screened crude sewage was continuously pumped into septic tanks 2 and 3, the calibrations of the flow periods being as follows: Tank 2, 16 hrs., November, 1905, to Jan. 20, 1906, and March 23 to November, 1906; 24 hrs., January 20, 1906, to March 1, 1906; 33 hrs., March 1 to March 23rd, 1906; Tank 3, 8 hrs.,

June 6 to November, 1906; 16 hrs., November, 1905, to March 23, 1906; 32 hrs., March 23 to June 6, 1906. The tanks were not drained, neither was any of the sludge removed until the conclusion of the tests. A brief summary of results of operations under the schedule outline is shown in Table II.

**Table II.—Average Composition of Septic Tank Effluents, Waterbury, Conn.**

(Parts per million.)

| | Flow period hours | | | | | | |
|---|---|---|---|---|---|---|---|
| | Tank 3 | | | Tank 2 | | | |
| | 8 | 16 | 32 | 16* | 16† | 24 | 32 |
| Oxygen consumed | 38 | 36 | 31 | 36 | 35 | 35 | 32 |
| Organic nitrogen | 8.5 | 10.3 | 8.2 | 6.9 | 9.8 | 12.6 | 10.5 |
| Free ammonia | 11.1 | 9.0 | 11.8 | 11.0 | 11.5 | 9.5 | 8.9 |
| Nitrites | .00 | .52 | .19 | .41 | .14 | .25 | .19 |
| Nitrates | .00 | .84 | .23 | .67 | .54 | 1.18 | 1.24 |
| Dissolved oxygen | .00 | 1.9 | 0.7 | 2.7 | 1.2 | 2.5 | 2.4 |

Observations upon the action of these tanks showed that they behaved in an unusual manner, most notably, perhaps, in the abnormally long time required to effect anaerobic conditions. At Columbus, Ohio (Report on Sewage Purification, 1905), it was found that the septic action was matured, if we consider such maturity as being shown by the first pronounced and continued ebullition of the gases of fermentation in the tank liquid taken in conjunction with the analyses of the effluent samples, in from 8 to 17 days, depending upon some function of the temperature, as may be shown by plotting a curve representing the time required for maturity. In evidence collected in England by the Royal Commission on Sewage Disposal, Mr. T. W. Harding stated that several weeks passed before evidences of fermentation appeared in the tanks at Leeds, England. Mr. E. G. Mawbey, Leicester, England, stated that septic conditions "began in about three weeks; about from a fortnight to three weeks; if it was hot weather they began sooner than in the cold weather;" Mr. Gilbert J. Fowler, Manchester, England, stated that "in the course of a few days (the tank liquid) will begin to give off gas, but it will be by no means thoroughly septic before some months."

In the case of the test tanks receiving Waterbury sewage no evidence of fermentative actions, as marked by the ebullition of gas, occurred until about the middle of May, 1906, or until more than eight months after the starting of the tanks. At this time small bubbles began to appear, but the gas formation was not sufficiently pronounced nor the bubbles of such size as to admit of their being "flashed" by a lighted match until the middle of June. From June to September the intensity and violence of the putrefactive action rapidly increased and the ebullition of gas during this period was exceptionally active.

A surface scum did not appear upon the tanks between September, 1905, and May, 1906; during this latter month a growth of green algae spread over the surface. Beginning in June, with the increased activity of the gas formation, small masses of sludge were thrown up from the bottom, forming a series of thin, temporary surface scums, each of which was dissipated by the first wind or rain. Gradually the turbulence in the tank became more pronounced and the sludge masses dislodged from the bottom increased in size, until in July they were frequently as large as a waterpail. These large masses soon formed a deep, dense and tenacious surface mat which was persistent. A handful of timothy seed was scattered over the surface of one of the tanks in July, and the grass growing therefrom attained, before frost, a height of about 8 ins. The grass roots grew throughout the surface mat and bound it together into a tough mass which tenaciously held together.

Besides the apparent inactivity of fermentative actions within the tanks between September and June, as shown by the absence of gas formation during that period, further proof may be shown by a study of the chemical data. The daily analyses of the crude sewage during the September-to-May period invariably showed the presence of nitrites, nitrates and dissolved oxygen in considerable quantities. In fact, during the entire period covered by the tests, even in midsummer, these three constituents were almost invariably present in the half-hourly and daily composite samples of crude sewage.

Throughout the colder months the parts per million of each have been higher than during the warmer months. The effluents of both septic tanks 2 and 3 upon analysis showed that previous to June all three of the constituents under discussion were present, although reduced in amount from that found in the crude sewage. The presence of available oxygen in the form of nitres, nitrates and dissolved oxygen (Table III.) in the effluents of the septic tanks obviously proves beyond a doubt that anaerobic conditions had not been established throughout the tanks and that the putrefactive and hydrolysing actions were feeble.

**Table III.—Dissolved Oxygen, Nitrites and Nitrates in Waterbury Sewage and Septic Tank Effluents.**

| | Crude sewage. | | | Septic effluents. | | |
|---|---|---|---|---|---|---|
| | Dissolved Oxygen. | Nitrites. | Nitrates. | Dissolved Oxygen. | Nitrites. | Nitrates. |
| Yearly average (Nov., 1905, to Nov., 1906) | 3.8 | 0.14 | 1.52 | | | |
| Seven months (Nov., 1905, to May., 1906) | 4.5 | 0.18 | 2.18 | *3.9 | 0.14 | 1.71 |
| | | | | †3.6 | 0.14 | 2.10 |

That tanks could receive sewage constantly from September 3 to May 1 of the next year, as these tanks did, without the establishment of active putrefactive conditions is a most interesting and remarkable occurrence.

In searching for an explanation of the unusual amount of available oxygen present in the crude sewage and the effluents of the septic tanks, in the form of oxygenated nitrogen compounds and in the gaseous state, the mode of sample collection and preservation, and the technique of the analyses were subjected to elaborate checks until definite and absolute proof of the correctness of the results was established. The flows through the tanks were studied until it was shown that the actual flow period did not materially differ from that calculated by the flow passing the gauging device, and an efficient system of baffles and scum boards was constructed in tank 2 which absolutely prohibited the sewage from passing through in any other than the rated period of time. The interposition of this baffling system did not effect, in the least, a change in the character of the effluent, nor did it assist in the promotion of putrefactive actions. A study of the average monthly analyses of tanks 2 and 3 shows that the anaerobic conditions were less complete in tank 2 than in tank 3 even in the face of the fact that the latter tank did not have a baffling system and that it was operated during the summer at twice the rate of the former.

As an explanation of the non-activity of putrefaction of fermentation in the sewage and the extreme slowness with which its available oxygen was exhausted, Table IV. has been prepared from data contained in the daily analyses of the crude sewage. The table shows, by months, the amount of nitrites, nitrates and dissolved oxygen in the sewage and also the oxygen consumed value as measured by a three-minute contact with an acidified solution of permanganate at room temperature, or its equivalent value, 20 per cent. of the 5-minute boil, the oxygen available in the oxygenated nitrogen compounds and in the dissolved gaseous state. Two ratios are shown: first, that existing between the available oxygen in the nitrites and nitrates and the oxygen consumed value, and second, that existing between the oxygen available in the

*Nov., 1905, to Jan. 20, 1906; †March 23 to Nov., 1906.

*Tank 2; †Tank 3.

form of nitrites, nitrates and dissolved oxygen and the oxygen consumed value. The highness of these ratios during the colder months amply explains, it is believed, the feebleness of the putrefactive action.

**Table IV.—Average Amount of Available Oxygen in Waterbury Crude Sewage as Dissolved Oxygen and Oxygenated Nitrogen Compounds.**

TABLE IV.—AVERAGE AMOUNT OF AVAILABLE OXYGEN IN WATERBURY CRUDE SEWAGE AS DISSOLVED OXYGEN AND OXYGENATED NITROGEN COMPOUNDS.

(Parts per 1 000,000)

| Month 1901 | Available oxy. as nitrates and nitrates | Oxy. consumed | Ratio Col. 1 — Col. 2 | Available oxy. as nitrates nitrates and dis. oxy. | Ratio Col. 4 Col. 2 |
|---|---|---|---|---|---|
| January . . . . . | 6.1 | 9.2 | 66 | 10.8 | 117 |
| February . . . . . | 4.47 | 8.0 | 56 | 8.11 | 101 |
| March . . . . . | 7.00 | 8.8 | 79 | 11.7 | 133 |
| April . . . . . | 8.01 | 8.4 | 95 | 12.11 | 144 |
| May . . . . . | 5.35 | 8.8 | 61 | 8.45 | 96 |
| June . . . . . | 2.43 | 8.4 | 29 | 6.03 | 72 |
| July . . . . . | 1.69 | 8.6 | 20 | 4.69 | 55 |
| August . . . . . | 1.27 | 9.0 | 14 | 3.87 | 43 |
| September . . . . | 2.54 | 10.4 | 25 | 4.74 | 45 |
| October . . . . . | 5.18 | 11.8 | 44 | 8.58 | 73 |

As further evidence bearing upon the time required for the exhaustion of the available oxygen and the establishment of putrescent conditions it may be said that 4-oz. samples of crude sewage collected during the winter of 1906 and incubated for 24 hours at 98 deg. F. still contained a small amount of available oxygen and were free from the characteristic putrescent odors or discolorations. The samples would, however, break down at the end of 30 or 33 hours incubation and show at that time a blackening, a depletion of the available oxygen and the presence of hydrogen-sulphide.

Observations upon the Naugatuck River substantiate the results of the above tests. The stream is grossly polluted and during periods of dry weather about one-third of the flow reaches it through the city sewers. Except during the months of July, August and September the nuisance caused by the polluting wastes is not apparent by odors or gases arising from the putrefaction of the organic matters.

A test was made March 14-17 upon tank 2 to show exhaustion of the dissolved oxygen. The tank influent was stopped at 8 a.m. March 14 and started again at 8 a.m. March 17, the retained liquid being held in a state of quiescence. Table V. shows that the available oxygen was exhausted at the end of 22 hours. The free ammonia increased slightly, with a corresponding decrease in the organic nitrogen. Upon the resumption of the influent flow the anaerobic conditions rapidly disappeared and the effluent returned to its normal quality.

**Table V.—Test for Oxygen Exhaustion, Septic Tank 2.**

| Date. | Nitrites. | Nitrates. | Dissolved Oxygen. |
|---|---|---|---|
| March 13, 8 a.m..... | 0.22 | .01 | 3.0 |
| *March 14, 8 a.m..... | 0.04 | .26 | 3.6 |
| March 14, 6 p.m..... | .02 | .22 | 2.5 |
| March 14, 12 mid..... | .01 | .23 | .30 |
| March 15, 6 a.m..... | .00 | .00 | .00 |
| †March 17, 8 a.m..... | .00 | .00 | .00 |
| March 17, 12 mid. ..... | .00 | .00 | 0.8 |
| March 18, 8 a.m..... | .14 | .70 | 2.0 |
| March 19, 8 a.m. ..... | .20 | 1.20 | 4.1 |

An exhaustion of the dissolved and other available oxygen from the septic tanks did not occur until June. Following this exhaustion the ebullition of gas became violent, causing great turbulence within the tank. The more active upheavals of gas, during this period of accentuated putrefactive action, put into suspension much finely divided organic matter, the complete exclusion of which from the effluent was practically impossible. This abnormal action of the septic tanks under the Waterbury conditions makes their control much more difficult than is generally the case, for throughout the colder months they operate practically as plain sedimentation tanks, the action of which is succeeded by a most violent fermentation during the summer months.

The sludge accumulating within these tanks during the first eight months of their operation had a coarse, fibrous texture, and a dark, grayish color and showed the result of but a small amount of bacterial action. In November, however, after the period of intensified bacterial action occurring throughout the summer, the sludge was well digested, finely divided and jet black.

The average flow periods of tanks 2 and 3 were 15.5 and 11 hours, respectively, the horizontal velocities being .08 and .11 mm. per sec. At the conclusion of the tests tank 2 held 1.07 and tank 3, 0.55 cu. yds. wet sludge per 1,000,000 gals. of sewage passed through. In each tank there had been deposited 0.25-ton of dry solids per 1,000,000 gals of sewage treated, and of this 56 per cent. was retained in tank 2 and 36 per cent. in tank 3 at the conclusion of the tests.

Under the same conditions that governed the septic tanks, tests were made with a plain sedimentation tank. The sludge was removed so frequently from the sedimentation tank that septic action never became established. The adaptability of the effluent from the sedimentation tank so far as its subsequent purification by filtration is concerned, has been substantially upon a parity with the more or less completely hydrolized effluents from the septic tanks. The principal advantage in the use of septic tanks under the local conditions appeared mainly in the economic disposal of the accumulating sludge.

The practicability of successfully treating the effluent from plain subsidence basins upon sand or sprinkling filters at high rates has much value in the present instance, as it admits of the efficient purification of the sewage almost from the time of filling the basins, the only lost time being that required in the development of the biological construction in the filters. Since Waterbury is under obligation to purify its sewage wastes only during the months between May and November, it is evident that through this parity of effluents the annual cost of pumping is greatly reduced, and further it is practicable to operate tanks at flow periods of 10 hours or less, whereas if a much more perfectly hydrolized effluent was required the flow period would necessarily exceed 32 hours.

Note.—The above experiments should be of great interest to those interested in septic action. They practically substantiate the conclusions of the British Royal Commission's Fifth Report. We note that no figures are given showing the actual digestion of sludge taking place in the tanks, as no allowance is made for the increased amount of solids passing off in the effluents during septic action. It is stated above: "The incessant upheaval of gas, during this period of accentuated putrefactive action, put into suspension much finely divided organic matter, the complete exclusion of which from the effluent was practically impossible."

In giving the percentage of sludge retained in tanks No. 2 and 3 as 56 per cent and 36 per cent., respectively, it would appear to have been useful to have known how the balance was accounted for, as between hydrolysis and gasification on the one hand and direct passage as fine particles with the tank liquor on the other. In comparing septic liquor with sedimentation liquor for secondary treatment in either contact beds or percolating filters, this is a most important consideration, the life of the filter and its fineness of material depending to a great extent upon the maximum removal of matters in suspension.

Ed San Review

*Influent shut off; †influent flow resumed

## SPECIFICATIONS FOR PILE AND PILING.

The city council of New York City decided to have their building code revised, and for this purpose they appointed a Building Code Revision Commission. This Commission consisted of engineers and architects of prominence, and many of their findings are of interest to engineers.

Two reports were submitted, a majority and minority report.

Both reports are quoted here and it will be seen the main difference is in connection with concrete piles, but even here there is great similarity.

### MINORITY REPORT.

#### Wood and Concrete Piles.

**Wood Piles.**

Wood piles may be of spruce, oak, longleaf yellow pine, Norway pine, or fir, but shall not be of hemlock or scrub pine. Piles shall be sound and straight. The diameter at the butt shall not be less than ten inches, and the diameter at the point shall not be less than six inches. The length shall not exceed twenty-five times the diameter at the butt.

They shall be driven to refusal if possible, and the method of driving shall be such as not to impair their strength. The centre to centre distance between piles shall not be more than thirty-six inches nor less than three times the average butt diameter.

If driven to refusal a maximum load per pile of fifteen tons may be used unless the load be otherwise determined by test. If not driven to refusal the maximum load per pile shall not exceed ten tons.

The Superintendent of Buildings shall be notified before any test is made of the sustaining power of piles so that he may be present or represented thereat. When doubt arises in regard to the safe sustaining power of piles in the soil upon which a building is to be erected, the Superintendent of Buildings shall order test piles to be driven by or at the expense of the owner of the proposed building. The record of such test shall be filed in the office of the Superintendent of Buildings.

The safe sustaining power, of a pile not driven to refusal, which shall in no case exceed ten tons, shall be determined by calculation based upon the following formula:—

$$L = \frac{2\,W\,H}{P + 1}$$

in which L = the allowable load in tons (maximum is 10 tons).
W = the weight of the hammer in tons,
H = the fall of the hammer in feet,
P = the penetration in inches under the last blow after the pile has sunk to a point where successive blows produce equal penetrations.

Piles shall be cut off so that the top is always below the level of mean low water. When required concrete shall be rammed down in the interspaces between the heads of the piles to a depth of not less than twelve inches and laterally for a distance of not less than twelve inches on each side of the rows of piles.

If piles are capped with timbers the timber shall be of sound, hard wood, not less than six inches thick and properly joined together. The tops of all such timbers shall be below the level of mean low water, except in the case of frame buildings built over water or on soft meadow, or similar land, in which case piles may project above the water a sufficient distance to raise the building above high tide and then the building may be placed directly thereon.

**Concrete Piles.**

The mixture used for concrete piles shall be one part of Portland cement; two parts of sand; three parts of broken stone which will pass through a ring three-fourths of an inch in diameter.

Concrete piles when not reaching rock or hardpan, and depending for their supporting power on friction between the surface of the pile and the surrounding material, shall not be loaded in excess of four hundred pounds per square foot of surface in contact with the soil, and shall not be driven closer centre to centre than three times their average diameter.

Concrete piles, when driven to a solid bearing, such as rock or hardpan, may be loaded to three hundred pounds per square inch of cross-section of pile, the cross-section being taken at the smallest point of the pile, provided sufficient steel reinforcement is embedded in the pile to provide against failure by shear or by bending when the pile is figured as a long column.

All steel reinforcement shall be embedded in the concrete forming the pile and shall be protected by at least two inches of concrete.

The loading per pile shall not be increased by reason of the steel reinforcement.

If the concrete piles are built in position and not driven, the forms are not to be removed until the concrete has obtained its final set.

### MAJORITY REPORT.

#### Wood and Concrete Piles.

**Wood Piles.**

(1) Wood piles shall be only of spruce, oak, longleaf or yellow pine, Norway pine or fir. They shall be sound and straight. The diameter at the butt shall not be less than ten inches, and the diameter at the point shall not be less than six inches. The length shall not exceed twenty-five times the diameter at the butt.

(2) They shall be driven to refusal if possible, and the method of driving shall be such as not to impair their strength. The centre to centre distance between piles shall be not more than thirty-six inches, nor less than three times the average butt diameter. If driven to refusal, a maximum load per pile of fifteen tons may be used unless the load be otherwise determined by test. If not driven to refusal the maximum load per pile shall not exceed ten tons.

(3) The Superintendent of Buildings shall be notified before any test is made of the sustaining power of piles, so that he may be present or represented thereat. When doubt arises in regard to the safe sustaining power of piles in the soil upon which a building is to be erected, the Superintendent of Buildings shall order test piles to be driven by or at the expense of the owner of the proposed building. The record of such test shall be filed in the office of the Superintendent of Buildings.

(4) The safe sustaining power, of a pile not driven to refusal, which shall in no case exceed ten tons, shall be determined by calculation based upon the following formula:—

$$L = \frac{2\,W\,H}{P + 1}$$

in which L = the allowable load in tons (maximum is 10 tons).
W = the weight of the hammer in tons,
H = the fall of the hammer in feet,
P = the penetration in inches under the last blow after the pile has sunk to a point where successive blows produce equal penetrations.

(5) Piles shall be cut off so that the tops are always below the level of mean low water. Concrete shall be rammed down in the interspaces between the heads of the piles to a depth of not less than twelve inches, and laterally for a distance of not less than twelve inches on each side of the rows of piles.

(6) Under frame buildings piles may be capped with timbers, the timbers shall be of sound, hard wood, not less than six inches thick and properly joined together. The tops of all such timbers shall be below the level of mean low water, except in the case of frame buildings built over water or on soft meadow, or similar land, in which case piles may project above the water a sufficient distance to raise the building above high tide, and then the building may be placed directly thereon.

**Concrete Piles.**

(7) The mixture used for concrete piles shall be one part of Portland cement, two parts of sand, and three parts of broken stone, which will pass through a ring three-quarters of an inch in diameter. The concrete shall be machine mixed.

(8) Steel reinforcement, which shall meet the approval of the Superintendent of Buildings, shall be provided to pre-

vent failure by shear or bending. The steel reinforcement, when imbedded in concrete, shall be protected by at least two inches of concrete. No allowance shall be made for steel reinforcement.

(9) The allowable bearing capacity of concrete piles shall be as determined by the Superintendent of Buildings.

## GRADE SEPARATION.

F. L. Somerville.*

(Continued from last week.)

**New York, N.Y.**

Park Avenue Viaduct Improvement. Eng. Rec., Vol. 34, page. 309.

The Grand Central Station at 42nd Street is the terminal of three railroads, viz.:—

The M. Y. C. & H. R. R. R., the N. Y. & H., and the N. Y. N. H. & H. About 500 trains a day run to and from it and pass through nearly five miles of the densely built portion of the city to the crossing of the Harlem River. There are four tracks which enter a tunnel soon after leaving the Grand Central Station and emerge from it at 96th Street beyond which there were formerly embankments and cuts nearly to the river which was crossed by a low level draw bridge.

In connection with the completion of the Harlem Ship Canal the United States Government required the bridge to be raised 14 feet, which necessitated the raising of the approaches which has been done by building a four-track steel plate girder viaduct from 110th Street to 134th Street, (a distance of 1¼ miles) on the south side of Harlem River and embankments and plate girder viaduct on the north side.

Harlem River Branch of the N. Y. H. & H. R. R. Engineering Record, Vol. 56, page 506, November 9th, 1907.

This track runs through a point near the junction of Harlem and East Rivers in the Borough of Bronx northward to New Rochelle where it joins the main line.

The traffic is largely freight, much of which originates on the line while there is a rapidly increasing suburban passenger traffic.

The main work done was to bring the road up to a six track line coincident with which and other improvements is a change of grade to eliminate grade crossings which was done by eliminating the track with subways for the streets or depressing it with overhead bridges for the streets as the levels of the land made advisable.

**Newark, N.J.** Population, 1900, 246,070.

Engineering Record, Vol. 48, page 806.

**Delaware, Lackawana and Western Improvement.**

In Harrison, which is separated from Newark by the Passaic River there were 13 crossings all at grade except four, which were subway. The track has been elevated and now all the crossings are subways.

In Newark there were 27 street crossings, all but one at grade. In order to reduce a heavy 3 per cent. grade the track was partly elevated and partly depressed, and all grade crossings abolished and four of the streets now cross the tracks by subways, the remainder by overhead bridges.

The maximum old grade was 3 per cent. The maximum new grade is 1.15 per cent.

In Newark the city pays part of the cost of the work, but in Harrison the railway bears the whole cost.

**Philadelphia, P.A.** Population, 1900, 1,293,697.

Philadelphia and Reading Track Elevation. Railroad Age Gazette, Vol. 65, page 612, July 31st, 1908.

In October, 1906, an ordinance was approved authorizing the Mayor of Philadelphia to make a contract with the railroad to elevate certain section of track on the line operated within the city.

This work was done on three sections.

The Philadelphia Germantown and Morristown from Green to Broad Street will be elevated, all streets will pass under the tracks of which the surfaces of four will be more or less depressed. For about 4,500 the track will be carried on steel viaduct having four tracks and the remainder will be on solid fill between retaining walls and steel bridges with solid waterproof floors. At Broad Street the grade is unchanged, that street and Lemon Avenue which intersects at the crossing being carried over the tracks by a bridge.

The P. G. & N. from a point north of Broad Street to the crossing of the Richmond Branch just south of the Wayne Junction will be elevated and carried over all the streets. The four tracks are carried on solid fill with masonry walls and steel bridges with solid waterproof floors, all streets appear to be more or less depressed.

On the Richmond Branch from the northeasterly part of the city the tracks are to be elevated from the bridge at Summerset to Richmond Street. This section includes a large yard which will also be elevated.

The extent of the work and the number of grade crossings which will be done away with are shown on the following table:—

| Sections. | Length, miles. | Grade crossings abolished. |
|---|---|---|
| P. G. & N., Green to Broad ..... | 2.2 | 21 |
| P. G. & N., Broad to Richmond.. | 1.5 | 8 |
| Richmond Branch ..... | 1.3 | 3 |
| | 5.0 | 32 |

The depression of some of the streets has made necessary a large amount of reversion of sewers.

Under the terms of the ordinance the cost of the work, including damages for change of grades of streets, etc., is to be evenly divided between the city and the railway, except that the latter pay the entire cost of additional cost.

**South Norwalk, Conn.** Population, 1900, 6,591.

Railroad Gazette, Vol. 28, page 613, September 4th, 1896.

The work in South Norwalk is part of the plan of elimination of grade crossings on the New York Division of the New York New Hampshire and Hartford Railroad, and at the same time provided increased traffic facilities by making a four track road.

The work described in the article is the raising of the grade about 15 feet, through the city of South Norwalk and across the Norwalk River a distance of about three fifths of a mile. This improvement connects with former work at the east end by descending grade of 30 feet per mile and on a level at the west end. It also entailed new connections with the Danbury Division and the Wilson Point Branch, single track lines, requiring a distance of half a mile on each to reach the old grade with a maximum of 40 feet per mile.

On the main line two grade crossings were abolished and three on the branches. All the material (sandy loam) for main line fill, about 200,000 cubic yards was brought 22 miles in 25 car trains, each car holding about 25 cubic yards.

**Seattle, Wash.** Population, 1900, 80,671

Terminal Improvements. Railroad Gazette, Vol. 37, page 510, November 4th, 1904.

The article gives the population as about 120,000, which shows a large growth since 1900. The city is one of the principal seaports on the Pacific Coast, and owing to the large amount of shipping the water front has become greatly congested and a large amount of additional land has been acquired east of the old railway terminals, on which to build new freight and passenger stations with the necessary yards and tracks.

Because of the peculiar conformation of the land on which the city is built the only way to approach the terminals from the north other than over the present line along the water front was to build a tunnel under the high ground of the business district. This was decided upon as it was imperative to do away with the congestion along the line of dock

*Consulting Engineer, Toronto, Ont.

## DISCUSSION OF VARIOUS PILES AND METHODS OF DRIVING THEM.*

By Frederic W. Swain.

Until recent years, the wooden pile has been used in nearly every case where the soil was too soft to carry the weight of the building to be imposed upon it. But now, since concrete has come into such general use as a construction material, the superiority of concrete piles has successfully been demonstrated. When concrete piles were first invented, wooden piles had been used for so many years that many engineers and architects considered them standard, and at first hesitated to use piles made of concrete; however, the use of concrete piling has increased rapidly each year, as its advantages have become more generally recognized.

The different types of piles may be divided into the following main heads:—

1. Wooden piles.
2. Concrete piles.
   - Method.
     - a. Molded.
     - b. Made in place.
   - Shape.
     - c. Tapered.
     - d. Uniform diameter.

**Wooden Piles.**—Owing to the fact that, unless wood is constantly kept saturated with water it will decay in a short period, the building laws of all cities require that wooden piles should be cut off at, or below, the level of the water

**Fig. 1.—"Broomed" Wooden Piles, Supposed to be in Good Condition, Until Excavated for Inspection.**

table. Whenever this level is a considerable distance below the surface of the ground, deep and costly excavation, sheathing and pumping are necessary in order to carry the foundation down to the tops of the piles. Such a foundation, with its deep excavation, and the excessive amount of stone or concrete required for its construction, is necessarily very expensive. There is a danger in cutting off wooden piles at the exact level of the ground water, due to the fact that frequently sewers or street drains are subsequently installed, or dams removed near the building, which may appreciably lower the level of the water table. Many buildings in Boston have been caught in this way, and before many years have passed it will be necessary to reinforce their present foundations.

Sometimes, under very heavy buildings, the whole area is filled with piles driven as closely together as conditions will permit. This is usually about two and one-half feet on centres. After the piles are cut off, a solid bed of concrete, into which the tops of the piles extend for perhaps six or eight inches, is laid over the whole area of the basement. To be sure, this practice ensures a rigid binding of the piles, but it gives an excellent opportunity for dry rot to take place in the wood which is embedded in the concrete. The bond between the concrete and the surface of the wood is very close and will permit little, if any, water to soak up into the top of the pile. Air, also, is largely excluded in the same way, and where these conditions exist dry rot is sure to take place before many years have passed.

In many localities the upper strata of the soil are fairly soft and are underlaid by a bed of stiff clay or hardpan. If wooden piles are driven in such soil no difficulty is encountered in driving through the soft material, but they are not sufficiently rigid to penetrate hard soil to any depth. Under these conditions the bearing power of the pile is limited nearly to its end support. The reasons for this are that the coefficient of friction between smooth wood and soft ground is low, that the frictional area of the pile is small, and that the compression of the soil, due to driving, is correspondingly small. Attempts to drive wooden piles into hardpan are attended with considerable danger of "brooming" the pile, and of course a "broomed" pile is worse than no pile. Many people claim that they know just what is taking place in the ground when a wooden pile is being driven, but such piles have frequently been exposed and found to be badly "broomed." When a pile is splintering in this way it apparently is in good condition because it is forced down under each blow, but instead of the point of the pile going deeper into the ground the fibres are merely buckling.

**Fig. 2.—Section of Wooden Pile, Showing the Destructive Work of the Teredo and Limnoria.**

Specifications usually call for wooden piles not less than eight inches in diameter at the butt, and six inches at the point. Such a pile, having a small end area, small friction surface, and low coefficient of friction, necessarily has only a low carrying capacity. The customary loads for wooden piles range from about six to twelve tons, according to the length of pile and the condition of the soil. Even a four-story manufacturing building may be as heavy as fifteen tons per linear foot of foundation, from which it may be seen that a great number of piles would be necessary safely to carry the building.

No pile is safe unless it is drawn vertically, and since it is seldom that wooden piles over twenty feet long are any-

*Abbreviated from the Harvard Engineering Journal.

where near straight, it is very difficult to drive them perpendicularly. If a pile is inclined to the perpendicular, its load is eccentric, which gives rise to serious stresses in the wood.

Wharf piles are subjected to alternate wetting and drying which, after a period of twenty years, will seriously decompose the wood. Other enemies of wooden piles in the water are the teredo and the limnoria, which honeycomb the pile and destroy it in a very few years. In the tropics this destruction takes place in about nine or ten months.

Wooden piles are driven usually either with a drop hammer or a steam hammer, the first being by far the more popular, because the energy of its blow is a definite quantity, whereas that of steam hammer is somewhat uncertain.

**Concrete Piles.**—All types of concrete piles have the advantage of their point of "cut-off" being independent of the level of the water table: that is, they can be carried to any height desired. Most concrete piles have a much larger carrying capacity than wooden piles.

Concrete piles are considered by some to be a luxury. As a matter of fact, under many conditions, they are an economy, because, although the cost per linear foot of pile for concrete is considerably greater than that for wood, the saving in number of piles, excavation, sheathing, pumping, foundation materials, and time of doing the work, far more than balances the greater cost of the piling itself.

**Molded Concrete Piles.**—Owing to the fact that there is so much handling necessary in the manufacture and installation of molded piles, the cost is comparatively high, but there are conditions where the molded pile is superior to other types, and is well worth the additional expense. One source of expense is the reinforcement, which is always necessary in molded piles, as protection against breaking in handling and driving.

Such piles are driven in three ways: With a drop hammer, a water jet, and a third method to be mentioned later.

Obviously it is unwise to use a drop hammer on a molded pile, because of the great danger of rupturing it.

The water jet is a safer method, but there is great danger of a larger hole being washed out than can be filled by the pile, hence the soil gives little or no lateral support to the pile. Not only is there lack of support in such a case, but there is also a lack of side friction. To be sure the coefficient of friction between smooth concrete and soft soil is not very great, but frequently it is surprising how much friction adds to the carrying power of the pile. When a pile is jetted down it is customary to tap it lightly with a hammer after jetting, to make sure that the end bearing is good.

The third method, and undoubtedly the most successful one of installing molded piles, is to drive by means of a drop hammer a heavy steel tube, fitted with an "alligator" point. This point, which is shown in the accompanying photograph, is similar to the "clam shell" dredge bucket, and is fastened to the bottom of the driving form by means of hinges, which allow the two sections to fall apart when the form is withdrawn. After the tube has penetrated to good bearing, a few cubic feet of concrete are deposited in the bottom of the form. Then a molded pile, slightly smaller in diameter than the inside of the driving form, is lowered into the form and forced into the plastic concrete. Then the heavy driving form is withdrawn, leaving the pile with a perfect end bearing and the necessary vertical support. The main advantage of this method lies in the fact that this driving form may be forced into stiff clay or hardpan, whereas it is impossible to penetrate such material with a jet. This being the case, the pile merely rests on the surface of the hard stratum, and has but little support from the soft overlying stratum against lateral forces.

**Concrete Piles made in place.**—For the sake of clearness we will call the two principl systems installing this kind of pile No. 1 and No. 2. Briefly No. 1 is as follows:—A fairly rigid, collapsible, tapered core, about which is placed a thin sheet-iron shell, is driven to the proper penetration and then the core is collapsed and withdrawn, leaving the shell in the ground. In system No. 2 a heavy steel tube of uniform diameter, having a detachable cast-iron point, is driven, then filled completely with concrete by means of bottom dump buckets, after which the driving form is pulled, leaving the cast iron point in the ground.

In system No. 1 the alleged object of leaving the shell in the ground is that concrete requires a form to keep out the water and protect it until it is set. It may be easily seen, however, that this shell is usually superfluous, because the compression of the soil about the pile itself constitutes a fairly rigid mold. As far as being sufficiently rigid to withstand the back pressure of the earth until the concrete has been placed is concerned, this shell is altogether inadequate. Besides, the use of a smooth shell appreciably reduces the friction force on the side of the pile.

When no shell is left in the ground, the surface of the concrete being very rough, a tremendous frictional value is obtained, which is capable of carrying a very large percentage of the load imposed upon the pile.

Piles made in place, if properly installed, have many advantages over other types in most soils. They are cheaper ordinarily than molded piles, because there is much less handling and less time required in installing them. Another advantage is that there is no possibility of injury to the pile in driving, as no concrete is placed until the form has been driven to the proper penetration.

In system No. 1 the concrete is shoveled into the form, which is bad practice, because the stone is very likely to separate from the sand and cement during the fall, thus giving an imperfect mixture.

Some people make the claim concerning system No. 2 that, since no shell is left in the ground to protect the concrete, the back pressure of the soil might squeeze the concrete, but the filling of the tube completely before the tube is drawn maintains a sufficient head of concrete in the tube to resist any possible earth pressure. In order to squeeze a pile in this way the back pressure of the earth must be great enough to lift the concrete bodily, and of course, this condition is an impossible one.

**Tapered Concrete Piles.**—The following discussion applies to tapered piles, whether molded or made in place.

Most tapered piles have the following dimensions: For a twenty foot pile, a six inch point and twenty inch butt, and for a thirty to forty foot pile, an eight inch point and an eighteen inch butt. Since the volume per linear foot of the pile is greatest at the butt, the compression due to driving is correspondingly greater at the surface of the ground that at the point. The friction area, also, is proportional to the volume, and the result of these two facts is that a greater proportion of the load per linear foot of pile is carried at the top. But since piling is necessary, it follows that the top soil is not capable of carrying a heavy load, and yet a very large part of the load on the pile is carried by the top five or six feet. This obviously is wrong, because the poorest soil is made to carry the heaviest load, and the firmest soil at the lower end of the pile carries a comparatively light load, and is not fully developed, inasmuch as the volume per linear foot of the lower end of the pile and the frictional area there are much smaller than at the top.

An example, showing how incorrect is the use of piles with small points, is the method of building plain foundation walls. Such a wall always rests on a broad footing, and is wide at the bottom and narrow at the top. The reason for this is that it is necessary to distribute the load over the ground, and not concentrate it on a small area. No man would ever put in a foundation wall narrow at the bottom and wide at the top, and is it any more reasonable to put in piles in that manner?

The so-called "wedge action" in a tapered pile is a myth. To be sure, there is a slight upward component to the force exerted by the soil upon the pile, but this is small, and is negligible, because it is much less than the loss in frictional force due to the small volume of the end of the pile.

The shortest driving form for this type of pile is about twenty feet. It is easy to see that if only a ten foot pile is driven its cross section is very small, the top being thirty

inches in diameter, while the point remains six inches. Hence the volume and frictional area are very much reduced, and if the usual load of thirty tons is imposed upon the pile, the concrete will certainly be overloaded. Allowing the customary four hundred and fifty pounds compressive stress to the concrete, a pile must be at least one hundred and thirty-four square inches in cross section in order safely to carry a load of thirty tons. To be sure the area of a thirteen inch circle is one hundred and thirty-three square inches, but the section of the pile at the point where the load is carried is probably several feet below the top of the pile, and hence at a point where the cross-section is very much less. This overloading of the concrete may be clearly shown if we take a definite example of conditions frequently encountered: if a tapered pile is driven through sixteen feet of soft top soil and then four feet into stiff clay or hardpan, practically the entire load is transmitted, without reduction, to the top of the

**Fig. 3.—Concrete Pile, Made in Place, Showing Lines of Compression.**

hard stratum, hence the whole load must be carried on a cross section of concrete at most not greater than the area of a nine-inch circle, or sixty-three and six-tenths square inches. Now if this pile is carrying the usual load of thirty tons, on not more than sixty-three and six-tenths square inches of concrete, the load per square inch would be nine hundred and forty-four pounds, which is far in excess of that allowed by the building laws of any city in this country. This overloading of the concrete is a very serious matter, and is a condition which should be strictly avoided.

**Concrete Piles of uniform diameter.**—This type of pile has a great many advantages over a tapered one, among which are: that the cross section of a short pile is as great as that of a long one, and hence there is no danger of overloading the concrete; also that piles of this type very seldom have sheet iron casings, so that the concrete comes in intimate contact with the soil about it, and actually becomes cemented to it; and since the surface of the concrete is naturally very rough, a tremendous friction value is present; also that the frictional area per linear foot of pile, and the intensity of compression due to driving, are constant throughout the length of the pile. The resistance of friction on such a pile increases steadily from nothing at the very surface of the ground to a maximum value at the point. This is the ideal condition, because the top soil, since piling is necessary in the locality, is not capable of carrying a heavy load, and the firmer soil, which is able to sustain a heavy load, is fully developed. If we disregard friction and consider only end bearing, the uniform diameter pile has a much larger point than a tapered one, because the diameter throughout the length of a straight pile is very nearly that at the butt of a tapering one. The diameter of the type of "uniform" pile, which has been used far more than any other system, is sixteen inches. Now compare the area of a sixteen-inch pile, 201 square inches, with those of six and eight-inch points of tapered piles. The area of an eight-inch circle is one-quarter of that area, or fifty and three-tenths square inches; and the area of a six-inch circle is twenty-eight and three-tenths square inches, or less than one-seventh that of a sixteen-inch pile.

A steam hammer is sometimes used for pile driving, but the ordinary drop hammer is by far the more popular. The reason for this being that there is absolutely no uncertainty

**"Alligator" Point—Open.**

as to the energy of a blow struck by a drop hammer, if the weight of the hammer and the distance through which it falls is known, whereas a steam hammer may apparently be making very heavy blows when actually the blow is comparatively light.

This article has considered conditions as they actually occur in practice, and no theoretical assumptions have been made. Recently the subject of uniform diameter versus tapered piles has been widely discussed, but many of these articles have been based on theoretical conditions such as are never encountered in practice. Mathematical calculations and niceties cannot rigidly be applied to piles of any kind, because conditions of the soil vary very greatly, and no reliable coefficients for friction value are possible except for individual cases.

## YEARLY COST OF BRIDGE.

The operating cost of the Brooklyn Bridge is found to be as high as $360,000 a year according to an investigation made by the controller of New York City. This figure is the average of ten years' maintenance and operating costs, beginning with 1898.

## CANADIAN ICE-BREAKING AND PASSENGER STEAMER.

The success of the Canadian ice-breaking and surveying steamer, "Lady Grey," completed three years ago at the Vickers Works at Barrow-in-Furness, has encouraged further development in the same direction. This earlier vessel, "Lady Grey," has done efficient work in breaking up the ice in the St. Lawrence River, and when not thus engaged has performed various duties associated with the Marine and Fisheries Board. The Canadian Government, in consequence, decided to order another and larger vessel from the Vickers Company, and this steamer, which was launched last month, marks developments, especially in size and speed. The Government authorities decided, in the interests of economy, carefully to consider the uses to which such a

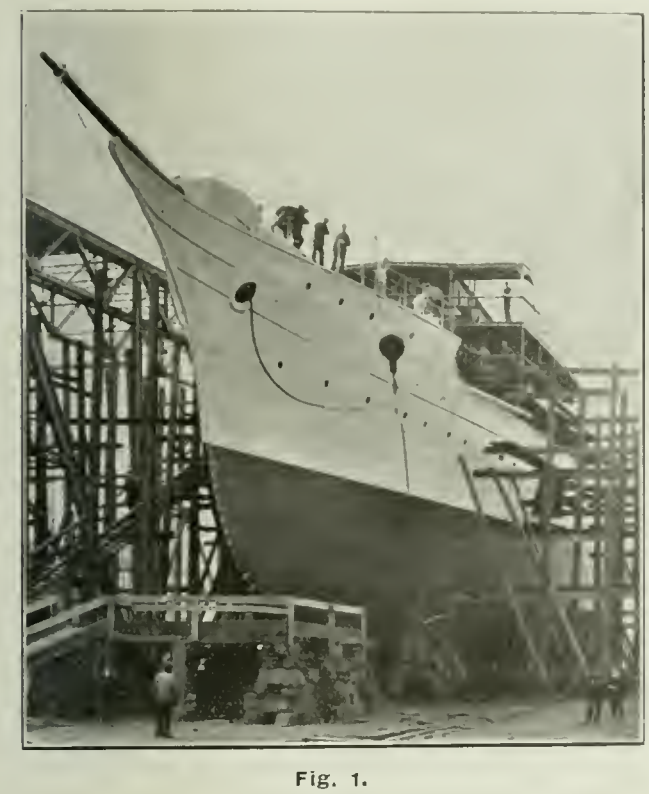


Fig. 1.

vessel could be put when there was no ice. The problem was a difficult one, in respect that the great strength necessary for ice-breaking involved a special form of hull; but the experience of the Vickers Company has enabled them to guarantee 17 knots, while forfeiting nothing of the essential qualities required for maintaining a free passage through the winter's ice. With the promise of this high speed, it was decided to fit the new vessel for passenger service, not only in winter, but throughout the summer season, across the Northumberland Straits, which separate Prince Edward Island from the mainland. At the same time the vessel has special quarters, so that she may be used as a yacht by the Governor-General, and is, therefore, appropriately named "Earl Grey." In view of this, the designers have achieved a remarkable success, so far as the appearance of the vessel is concerned. While the strength of the hull is obvious at a glance, grace has been lent to the appearance not only by fine shear, but by the adoption of a cut-water stem and a short bowsprit, an elliptical stern, and two steel pole-masts, which have a considerable rake, and are schooner-rigged.

A closer examination, however, shows that a consideration of strength has dominated the design of the hull, in order that effective work may be done amongst the heavy ice-fields of the Northumberland Straits and the Gulf of St. Lawrence. The frames are very closely spaced, in order to take up the thrust of the pack-ice, which will, at times, be piled around the vessel. The shell plating is thicker than usual, and the outer skin is doubled along the water line right fore and aft and to the bottom of the keel in the fore-body, where the friction of the ice tends, in the case of ice-breaking steamers, to wear away the material faster than in ordinary marine practice. As is well known, the procedure is to drive the ship forward until the forebody glides on to the floe sufficiently far to cause the ship's weight to crush the ice. In order that the weight may be increased at will, large tanks are built into the structure, and the pumps for filling and emptying these tanks deal with 250 tons of water per hour. The vessel is also equipped for breaking ice when going astern, and the counter has been suitably strengthened to resist the shocks. The rudder takes the form of the vessel, so that the movements of the ship are not in any way impeded by the ice floes.

The dimensions of the vessel are tabulated alongside those of the earlier steamer, which was named the "Lady Grey."

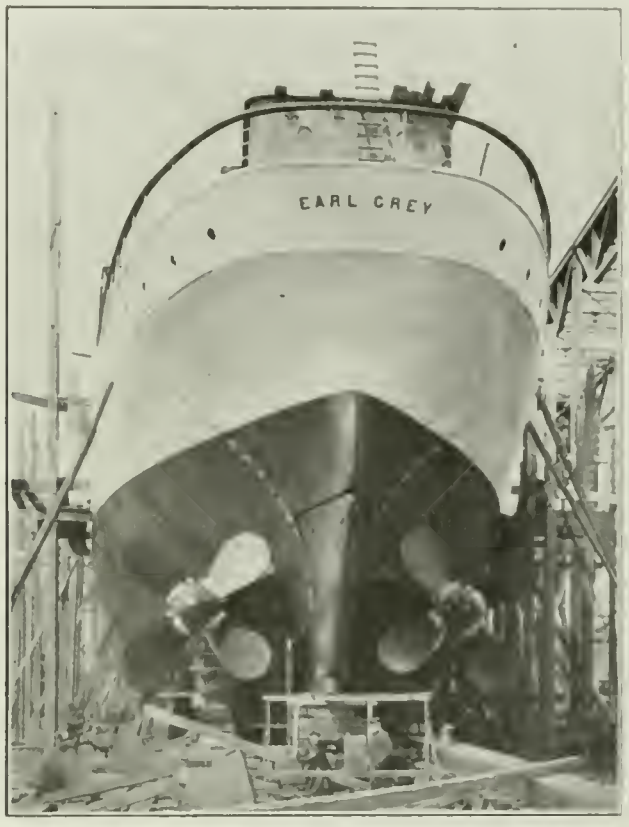



Fig. 2.

| | "Lady Grey" | "Earl Grey" |
|---|---|---|
| | Ft. | Ft. In |
| Length between perpendiculars | 172 | 250 0 |
| Breadth, moulded | 32 | 47 6 |
| Depth, moulded | 18 | 26 6 |
| Draught, normal | 12 | 17 7 |
| Displacement | 1,055 tons | 3,400 tons |
| Speed | 14 knots | 17 knots |

The arrangement for the accommodation of passengers is on the promenade, upper, and main decks, while above this is the bridge-deck, which contains the quarters for the captain and navigating officers in the deck-house, the roof of which serves also for the navigating bridge. The apartments for the Governor-General, together with the smoking-room, are placed in the deck-house on the promenade deck, in which also there is arranged the entrance-hall and lounge for first class passengers. A broad companionway leads down to the upper deck, where there are arranged staterooms for fifty first class passengers, as well as the first class dining saloon, pantry, galley, etc., while the chief engineer has his quarters close to the engine-room; on this deck also the petty officers of the ship are accommodated. The mail-rooms are aft on this deck, and the seamen are accommodated forward. The second class accommodation, which affords room for twenty passengers, is on the main deck, where also the remainder of the engineers and others of the crew of the ship have their accommodation. On this level, too, there is a hold for light cargo.

The vessel is subdivided into numerous watertight compartments, and the doors of the principal compartments are ... the Stone-Lloyd system, so that they can be closed simultaneously from the navigating bridge. A watertight bunker bulkhead extends on each side of the vessel throughout the length of the boiler-rooms, and a double bottom is fitted for almost the entire length of the vessel.

The vessel is lighted throughout with a complete system of electric light, and is heated by steam. Arrangements are provided for rapidly handling the cargo and for coaling expeditiously.

The machinery is of the triple-expansion, three-crank type, and in the design the heavy stresses to which the vessel will be subjected in ice-breaking have had special consideration. Consequently, the shafting and the working parts are of considerably greater strength than usual. This also applies to the propellers, which are of the four-blade, built-up type. The blades which, like the bosses, are of cast-steel, are of exceptional strength for working through ice. The engine cylinders are 27½ in., 43 in., and 70 in. in diameter, respectively, with a stroke of 39 in. Steam is supplied at a working pressure of 180 pounds from four boilers of the cylindrical type, 15 ft. in diameter. Two of these are double-ended, being 21 ft. long, and two single-ended, 11 ft. long. The boilers are fitted with furnaces of the Morison suspension type, and work with the Howden system of forced draught, the air being supplied by three fans driven by enclosed forced lubrication engines. The main condensers are cylindrical in form, and independent twin air-pumps are provided. There is also an auxiliary condenser capable of dealing with the whole of the steam from the auxiliary engines, and having separate air-pumps.

Special arrangements have been made in connection with the pumping plant, owing to the special duty of the ship in the ice-floes. In the event of the ordinary suction or discharge valves being choked with ice, the circulating water may be drawn from or discharged into a part of the double bottom, two frame-spaces being specially divided off for this purpose. In the way of these the outer skin of the ship is perforated in such a manner as to give a large area for the passage of the circulating water. Steam jets are arranged on the branches of all sea inlet valves, to enable them to be cleared of ice as occasion arises. A ballast-pump of the centrifugal type, capable, as already stated, of dealing with 250 tons of water per hour, is fitted in the engine-room, with connections for transferring water between the forward and aft tanks when trimming the vessel for making its way through the ice.

In addition to the usual feed, bilge, and sanitary pumps, the machinery department is fitted with evaporating plant, grease-extractor, feed-heater, and Stone's ash-expellers, the equipment generally embodying the latest up-to-date practice for this class of vessel.

A workshop for repairing purposes is installed on the vessel, the lathes and other machines being driven by electric motor.

The machinery, like the ship, has been built to the requirements of the Board of Trade, Lloyd's Registry of Shipping, and the Canadian Steamboat Inspection Act.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

7318—June 19—Dismissing application of the village of Coteau Station for Order directing the G.T.R. to cease wilfully permitting its engines, and cars, and trains to stand at the highway at the level crossing at Coteau Station for a longer period than five minutes at one time; and in shunting to obstruct public traffic on highway for a longer period than five minutes at one time.

7319—June 17—Directing the Grand Trunk Railway System to install an automatic electric bell with a cut-out opposite the station, at the village of Morrisburg, Ont.

7320—June 19—Approving plans of the location of the C.N.R. through the city of Saskatoon, Sask., also proposed subway to be constructed at 22nd, in the said city.

7321—June 21—Granting leave to Elric Archambault, of Primeauville, County of Chateauguay, P.Q., to erect, place, and maintain electric light wires across the track of the G.T.R. on the main street in the town of Ste. Martine, P.Q.

7322—June 19—Directing the C.N.R. to install an interlocking plant where its lines cross the line of the C.P.R. at Gladstone, Man.

7323—June 22—Approving revised location of a portion of the C.P.R. Company's New Westminster branch in the city of New Westminster, B.C.

7324—June 22—Authorizing the G.T.R. to reconstruct 14 bridges on the Eastern Division of its line.

7325—June 22—Amending Order No. 3258, of July 6th, 1907, by striking out clause "h" of the said Order.

7326—June 19—Dismissing complaint of G. B. Janes & Company, of Orillia, Ont., complaining that the rates charged by railway companies on cheese box veneers are excessive.

7327—June 22—Approving plan of the proposed new iron bridge, to replace the present wooden bridge carrying Avondale Avenue, Stratford, Ont., across the right of way and track of the G.T.R. at mile 116.75 on the 20th Dist.

7328—June 22—Directing the C.P.R. to install and maintain gates at the crossing of the C.P.R. where it crosses Columbia Avenue, leading to Evans, Coleman & Evans Wharf, Vancouver, B.C.

7329—June 23—Authorizing the C.P.R. to open for the carriage of traffic that portion of its second track of its double track, Ignace Section, from mileage 115.0 to mileage 119.8; a distance of 4.8 miles, and from mileage 120.0 to mileage 127.8; a distance of 7.8 miles.

7330—June 23—Approving Standard Passenger Tariff of the Grand Valley Electric Railway, C.R.C., No. 3.

7331—June 8—Directing the C.P.R. to construct a subway in the city of Montreal, P.Q., under its tracks, where same crosses Iberville Street, Montreal, P.Q.

7332—June 22—Authorizing the G.T.R. to construct, maintain, and operate branch line to and into the premises of the Frost Wire Fence Company, Hamilton, Ont.

7333—June 22—Authorizing the C.P.R. to reconstruct two bridges; one on its Lake Superior Division, No. 42.55; and one on its Eastern Division, No. 0.3.

7334—June 22—Granting leave to the Western Counties Electric Company, to erect, place, and maintain its wires across the track of the T. H. & B. Railway, on Oak Street, Brantford, Ont.

7335—June 23—Authorizing the C.P.R. to construct, maintain, and operate spur for the Asquith Milling Company in the town of Asquith, Sask.

7336—June 23—Rescinding Order No. 7299, dated June 16th, 1909, directing the Western Counties Electric Company to maintain its electric wires across the track of the G.T.R. at Elgin Street Subway, Brantford, Ontario.

7337—June 22—Amending Order No. 7023, dated May 10th, 1909, by striking out clause 2 of the said Order; Order No. 7023 approves Supplement No. 1 to Canadian Classification No. 14.

7338—June 21—Dismissing application of the Canadian Pacific Railway for Order rescinding or varying an Order of the Privy Council, dated May 13th, 1908; whereby the C.P.R. were ordered to leave an opening in a trestle bridge carrying a branch line of its railway to Dixon's Mills, Peterboro, Ont., across the channel of the Otonabee River, by permitting the C.P.R. to fill said opening and substitute for the trestle a solid embankment.

7339—May 4—Ordering the G.T.R. and C.P.R. to protect, by folding gates, to be installed within four months from date of Order, crossing at Collage Street, Lennoxville, P.Q.

7340—June 23—Granting leave to the C.P.R. to construct its railway across the highways in the Township of Medonte,

at mileage 12.96, 0.07, and 0.13, on "Y" of the Georgian Bay & Seaboard Railway.

7341—June 24—Authorizing the C.P.R. to construct additional track across public crossing from Sudbury to Azilda, at a point near Murray Station Grounds, Township of McKim, Ont.

7342—June 24—Authorizing the C.P.R. to construct additional track across Orr Street, Calgary, Alta.

7343—June 23—Dismissing and refusing four complaints of the Produce Merchants' Association of Montreal, P.Q.; also ordering that on cheese shipped from points west Montreal to Montreal on separate rail bills of lading, the railway companies absorb the wharfage and port warden's fee when such cheese is subsequently exported from the port of Montreal; said absorption to continue so long as it is applied in the case of cheese shipped on joint rail and ocean bills of lading to Europe, the tariffs of the railway companies to provide for such absorption to be filed and published and to become effective within thirty days from the date of this Order.

7344—June 25—Authorizing the C.P.R. to reconstruct two bridges on its line, No. 20.2, Blagdon Brook, St. John Section, Atlantic Division, and No. 3.4, near St. Sabine, Stanbridge Branch, Eastern Division.

7345—June 24—Granting leave to the rural municipality of Miniota to erect, place, and maintain its wires across the track of the C.P.R. at Arrow River, Man.

7346—June 24—Granting leave to the Riverside Telephone Co., Limited, to erect, place, and maintain its wires across the track of the C.P.R., between Sections 23 and 26, Township 14, Range 22, west second meridian, Sask.

7347—June 23—Granting leave to the village of Warman, Sask., to erect, place, and maintain its wires across the track of the C.N.R. at Warman, Sask.

7348—June 24—Granting leave to the Bell Telephone Co. to erect, place, and maintain its wires across the track of the M.C.R.R. at public crossing two and a half miles north-east Welland, Ont.

7349—June 25—Reporting to the Governor-in-Council for sanction By-law No. 94, adopted by the directors of the C.P.R. re spitting in cars and on railway premises.

7350—June 23—Amending Order No. 5102, dated July 20th, 1908, authorizing the G.T.R. to install interlocking plant at the crossing of the C.P.R. east of Weston Road, Toronto Junction, by providing that the work of installing said interlocker be performed by the C.P.R.

7351—June 25—Approving plans showing drawbridge of the O. and N.Y.R. over the Cornwall Canal.

7352—June 25—Amending Order No. 7076, dated May 26th, 1909, granting leave to the G.T.P.R. to construct its railway at grade across the highway between Section 7, Township 48, Range 13, and Section 12, Township 48, Range 14, west fourth meridian, District of North Alberta, by striking out the last clause of the Order.

7353—June 25—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for the Consolidated Mining and Smelting Co., Kootenay District, B.C.

7354—June 25—Authorizing the C.P.R. to construct, maintain, and operate an industrial spur for Messrs. George & Robinson, Macleod, Alta.

7355—June 25—Granting leave to George Coultis & Son to erect, place, and maintain wires across the track of the G.T.R. at King Street, Thedford, Ont.

7356—June 25—Authorizing the Toronto, Hamilton and Buffalo Railway to construct, maintain, and operate spur to and into the premises of George Ritchie, Hamilton, Ont.

7357—June 25—Authorizing the C.P.R. to construct, maintain, and operate spur in the town of Lethbridge, Alta.

7358—June 25—Authorizing the C.N.O.R. to take, for the purpose of avoiding a sink-hole, part of Lot 12, Concession F, Township of Medora, District of Muskoka, Ont.

7359—June 3—Approving plan showing crossings of Dufferin, Dunn, Jamieson, Dowling, Sunnyside, and Howard Avenues and Indian Road, in western end of Toronto, by the G.T.R. and C.P.R., and several streets in the Township of Etobicoke, Ont.

7360—June 26—Extending for a period of sixty days from July 1st, 1909, the time within which the work directed to be constructed in connection with the Richmond Road Crossing, Ottawa, Ont., be done.

7361—June 3—Ordering the G.T.R. to provide better protection at the level crossing, known as Sunnyside Crossing, Toronto, Ont.

7371 to 7373—June 29—Granting leave to the Alberta Government to erect, place, and maintain its wires across the C.P.R. at Erskine, between Sections 9 and 15, Township 44, Range 16, west fourth meridian, and near Medicine Hat, Alta.

7374—June 29—Granting leave to the Creston Power, Light and Telephone Co. to cross the track of the C.P.R. at Creston, B.C.

7375 and 7376—June 29—Granting leave to the Malahide and Bayham Telephone Association, Limited, to erect, place, and maintain its wires across the track of the C.P.R. at Griffins, Ont., and east of the town of Tillsonburg, Ont.

7377 to 7386—June 29—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the Canadian Pacific Railway at ten places in the Province of Alberta.

7387—June 21—Granting leave to the Bell Telephone Co. to erect, place, and maintain its wires across the track of the T.H. and B.R. at public crossing one and a quarter miles east of Cainsville Station, Ont.

7388—June 30—Rescinding Order No. 7338, dated June 28th, dismissing application of the C.P.R. for Order rescinding or varying an Order of the Railway Commission of the Privy Council, dated May 13th, 1898, under which the C.P.R. was ordered to leave an opening in a trestle bridge carrying a branch to Dixon's Mills, Peterboro', Ont., as Order No. 7338, dismissing application, was issued by mistake.

7389—June 29—Authorizing the G.T.P.R. to construct five bridges in the Province of British Columbia.

7390—June 29—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for the Lethbridge Brewing and Malting Co., Lethbridge, Alta.

7391—June 29—Authorizing the C.P.R. to reconstruct one bridge on its Atlantic Division No. 23.53, and No. 101.5 on its Pacific Division.

7362—June 29—Recommending to the Governor-in-Council for approval the rules and regulations of the Niagara, St. Catharines and Toronto Railway Co.

7363—June 29—Approving location of the C.P.R. Co.'s Manitou Lake Branch from mileage 0 to mileage 51.33.

7364—June 29—Approving location of the C.P.R. Co.'s Langdon-North Branch from mileage 45 to mileage 60.

7365—June 29—Authorizing the Georgian Bay and Seaboard Railway Co. to open for traffic that portion of its line between Coldwater Junction, on its Toronto-Sudbury Branch, to Maple Island, on Hog Bay, in the vicinity of Victoria Harbor, a distance of thirteen miles.

7366—June 29—Approving location of the C.P.R. Co.'s Langdon Branch from Langdon, a short distance east of Calgary in a north-east direction, mileage 0 to mileage 45.

7367—June 25—Dismissing application of the Transportation Bureau of the Montreal Board of Trade for an Order directing a reduction from the second class rate on ingot tin, in the Canadian Classification, to third class, as in the Official Classification.

7368—June 28—Amending Order No. 7284, dated June 8th, 1909, authorizing the construction of a spur at Mile End, town of St. Louis, District of Montreal, across Sanguinet Street, by adding the word "indemnified" in the first line of the second clause of the said Order.

7369—June 29—Granting leave to the E. and N. Railway to construct its railway across the highways at mileages 96.9, 91.2, and 95.93 of its Wellington and Alberni Branch, British Columbia.

7370—June 29—Authorizing the C.P.R. to open for traffic portion of second track of the double track of its line of railway, Kenora Section, from mileage 13.8 to mileage 16.0, a distance of 2.2 miles.

## THE SUCTION GAS PRODUCER FOR SMALL POWER PLANTS.*

C. J. Atkinson.

Of late years the producer has been gradually gaining in favor as a means for supplying gas to operate gas engines, and having been asked to contribute a paper, I do not think I can do better than explain the principles by which these machines work. It is a subject of importance to all internal combustion engine builders or the users of internal combustion engines, and being one with which I am perfectly familiar, having devoted in the past a large amount of time to this subject, and at present all of my time.

When we speak of gas producers we mean that class of machine that makes a gas by what might be termed a partial combustion method, although any machine that makes gas, whether it is by distillation or evaporation, might equally be termed a gas producer, but the term gas producer, although not a descriptive one in the strictest sense of the word, has come to mean and is generally understood to mean a machine for manufacturing a cheap, low grade of gas suitable for power and fuel purposes.

Gas producers can be divided into two classes, namely, pressure and suction. The difference between them being that those of the pressure type work above atmospheric pressure, while those of the suction type work slightly below atmospheric pressure. In other words, in the pressure producer, the gas is under a slight pressure caused by forcing of air and steam into the generator. In the suction type of producer the pressure is reduced below atmospheric pressure by drawing the gas away from the producer either by means of an exhauster, or allowing the engine, which is being supplied with gas, to suck it. Theoretically, the process of gas making is the same in both cases. The suction producer has been more developed of late than the pressure, and as now manufactured is complete in itself.

Gas producers use as fuel, coal, coke, charcoal and wood, all substances rich in carbon. We, for the purpose of describing, will imagine at first that we are using carbon as fuel.

If we have a cylindrical casing lined with a refractory material having at its lower extremity a fuel supporting grate enclosed by an ash pit having a passage for the admission of air, etc., while at the top of the cylindrical shell we have a gas outlet and a means for admitting fresh fuel without allowing either gas or air to pass.

With such a machine we can make a number of experiments.

As is well-known, the atmosphere consists of about four-fifths nitrogen and one-fifth oxygen. But we, for the purposes of explaining the action of air upon incandescent carbon, will assume at first that there is no nitrogen, as in practice it only acts as a dilutent. If we have a shallow fire in our producer and an abundant supply of air, the carbon will be completely consumed. The products of combustion being $CO_2$ and a large quantity of heat will be developed; for instance, one pound of carbon completely consumed would give us

$$C+2O=CO_2+14640 \text{ B.T.U.},$$

but if there was a considerable depth of fire in the producer, as there should be in practice, the resulting gas would be CO instead of $CO_2$, for when there is an excess of highly heated carbon the $CO_2$ formed in the lower part of the fire is reduced to CO with an absorbtion of heat

$$CO_2+C=2CO-5820 \text{ B.T.U.}$$

Therefore we see that it is absolutely necessary that there should be a deep fire so that these two reactions can take place. It is not absolutely decided that these two reactions are what goes on inside the gas producer. It may be that the carbon is changed direct into CO, as illustrated by the third equation,

$$CO_2+C=2CO+8820 \text{ B.T.U.},$$

or it may be that all of these reactions take place, but the result is the same. We get carbon monoxide formed plus a certain amount of heat liberated and the gas would have the following composition, taking into consideration the nitrogen of the air, carbon monoxide 34.7, nitrogen 65.3. Now, if the producer was so constructed that no heat could leave the fuel column, the temperature would increase to such an extent as to be impracticable but some heat will escape through the brick lining or will be carried away as sensible heat in the gas formed. This is, therefore, a loss, and to avoid this loss as far as possible is it best to keep the temperature of the fire within due bounds. This we are able to do by mixing a certain proportion of steam with the in-going air, which steam will be decomposed and so absorb some of the heat which would otherwise be carried away. The reaction of steam upon heated carbon may be as follows, providing the fire is of sufficient temperature:

$$H_2O+C=H_2+CO-8740+4420 \text{ B.T.U.}$$
$$=H_2+CO-4320 \text{ B.T.U.}$$

If the temperature of the fire is too low, another reaction will take place,

$$2H_2O+C=2H_2+CO_2-2820 \text{ B.T.U.}$$

It will be observed that in both cases there is a large absorption of heat, and it is at once apparent why a very small quantity of steam reduces the working temperature. The effect of the presence of steam in the air blast is that a smaller proportion of the total heat of combustion is liberated in the form of sensible heat in the producer, but a corresponding larger proportion is available when the producer gas is used.

It should be understood that from the point of view of heat quantities the use of steam in the gas producer is simply a means of absorbing the sensible heat developed by the partial combustion of carbon and storing it for future use. There can be no actual increase in the total quantity of heat which can be obtained from a given weight of fuel. Besides avoiding excessive heat in the producer, the steam has a further practical advantage, in that a gas of greater calorific power per unit volume can be obtained than when air is used alone. It has been shown that for every volume of carbon monoxide in the gas made with air alone, there must of necessity be 3¾ volume of nitrogen, but where steam is used the gas which is formed by its decomposition is free from nitrogen, therefore the larger the quantity of steam used the richer the gas per unit volume, but as we see from the figures, there is a limit to the quantity of steam that can be used, due to its cooling action on the fire. This quantity is not the same in all producers, as some producers are so constructed that less heat escapes through the lining or is carried away with the gas.

In designing a producer it is necessary that the velocity of the steam and air through the fuel column should not be excessive, otherwise there is no time for the reaction to be completed, and the fine ashes of the fuel will be carried upwards, so choking the fuel column. It is also necessary that where the load on the engine or the demand for gas is variable the amount of steam should be varied and varied in greater proportion than the variation of the load. Also we have seen that by insulating the fuel column, extracting the sensible heat from the gas and returning it to the fuel column by some means or other, we can make a richer gas, as the fire will then stand a larger proportion of steam, there being less loss of heat.

Theoretically, the maximum amount of steam that an ideal producer would stand is 64 pound for every pound of carbon consumed. But it is impossible to use this quantity in practice and still have the whole of it converted into hydrogen and carbon monoxide. If a larger quantity is used it will still be decomposed, but will give a certain amount of carbon dioxide. This carbon dioxide is formed because of the

*Read before National Gas and Gasoline Engine Trades Association, June 22, 1909.

lower temperature of the fibre. In practice we aim to keep our fire at the maximum temperature permissible, which temperature is limited by the ash contained in the fuel used and depends upon the temperature at which this ash fuses. With most of the American coals we can make a producer in which the amount of carbon dioxide runs about 4 per cent., but to do so we have to keep as much heat in the fire as possible.

In the theoretical gasification of anthracite coal, 80 pounds of carbon converted into carbon monoxide gives us 186.66 pounds of this gas, or a percentage volume of 33.4. Five pounds of carbon completely burnt to carbon dioxide, gives us 18.33 pounds, or a percentage volume of 2. Five pounds of volatiles, hydro-carbons distilled, gives us 5 pounds of hydro-carbon gas, which equals 1.6 per cent. volume. One hundred and twenty pounds of oxygen are required, of which 30 pounds are supplied by the decomposition of the water. Ninety pounds of oxygen are furnished by the air, and the associated nitrogen with it gives us of this gas 301.05 pounds or 35 per cent. In calculating the energy in the above gases obtained from 100 pounds of anthracite, the carbon monoxide gives us 807,304 heat units; the hydro-carbon or marsh gas gives us 117,500 heat units, while the hydrogen gives us 232,500, making a total of 1,157,304, or a heat value of 152.7 B.T.U. per cu. ft. The efficiency of the conversion is 86 per cent. This theoretical gasification is practically what should be obtained in the modern suction gas producers.

One of the first to apply producer gas to internal combustion engines was Dowson. In 1881 he showed a 3-h.p. gas engine operating with this gas, before the British Association for the Advancement of Science. His producer was of the pressure type, and was a complicated piece of apparatus, consisting as it did of a steam boiler, the steam from which was utilized for putting the plant under pressure and supplying the moisture to the ingoing air. The generator worked intermittently, due to the large amount of steam being used; in addition, there were various gas coolers, a scrubber and gas holder to supply the engine with gas when the fire in the generator had to be blown up. The next historic producer was built by Lencanshez, where the same principle was used, but the steam boiler was combined with the gas producer, the necessary steam being raised by utilizing the heat from the outgoing gas. This producer worked fairly well, when coal with a very small amount of ash was used, otherwise there were clinkers formed, due to there not being enough steam generated.

Bollincks introduced a producer of the suction type, which works in a very similar manner to the one just described; the principal difference being that instead of putting a steam boiler on top of the producer it is fixed at the side, the gas passing out and through it, this arrangement giving a very much larger heating surface. This producer was the first to work on the suction principle. They gave fair satisfaction over in Europe, principally due to the good quality of the fuel used.

Pintsch invented a producer of the suction type. In this producer the gas and steam was generated in the pan of the upper part of the fuel column and derived its heat from the outgoing gas. This plant required a lot of attention, as it is necessary to charge it with fuel often, otherwise the green coal being introduced cools down the vaporizer, and so affects the quality of the gas.

In this country there is a producer built on practically the same lines as the Pintsch, but slightly improved, in that the vaporizer is placed lower down the fuel column, therefore it is not affected to the same extent upon the introduction of fresh fuel, and more steam can be generated, which is necessary when American fuels are to be used. We now come to another type of producer. In this producer the generator has no vaporizer attached to it. It consists of just as simple a piece of apparatus as it is practical to build. In order to secure the necessary steam with which to enrich the gas and to prevent clinkers, a separate vaporizer is used, which secures its heat from the exhaust of the gas engine. This vaporizer consists of a number of cast iron circular chambers

(Continued on Page 30.)

# ENGINEER'S LIBRARY

## WORKS OF REFERENCE.

The engineer must ever be a student. The progress in engineering science is as great as the progress in any other study. To keep pace with this progress the engineer must not only design and build and experiment, but he must read and study and index the methods and processes described by others.

It is impossible for a man to read all the books written on his particular subject, and yet he wishes to know what has been written, and from these select his works for study and reference.

The purpose of our book review department is to give an outline of what each book contains, so that the reader may know at a glance its value to him. Usually, the reviews are prepared by engineers actively engaged on work akin to subject matter in the book reviewed.

The index to Volume XVII. will contain a list of books reviewed, so that our readers may have an index to a reference library index.

It is not only books that are of value, but frequently catalogues and reports contain information useful to the engineer and contractor, and for this reason we give monthly a list of the more useful catalogues. These, too, are very useful for reference purposes.

Altogether, we consider our Engineers' Library one of the most valuable sections of The Engineer, and we hope to improve it by additions and new features.

## BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department Canadian Engineer, 62 Church Street, Toronto.

**Laboratory Experiments in Metallurgy.** — By Albert Sauveur and H. M. Boylston: published by the authors, Cambridge, Mass. Size, 8 x 10; pages, 150; cloth. Price, $1.25.

These short notes, describing some experiments in metallurgy, are written primarily for the use of students at Harvard University who take the courses in General Metallurgy and in the Metallurgy of Iron and Steel. The authors hope that these notes may prove suggestive, at least, to other teachers and students in metallurgy, and even to practitioners of the art.

Mr. Albert Sauveur is professor of Metallurgy and Metallography at Harvard, while Mr. H. M. Boylston is instructor in Mining and Metallurgy at the same university.

The work is divided into two parts. Part I. deals with General Metallurgy, and Part II., the Metallurgy of Iron and Steel. The apparatus and experiments are described, and at the end of each experiment there is a form for recording the results. The book is conveniently arranged, useful, and will be much used in science colleges.

**Thermal Properties of Steam.** — By L. S. Marks and H. N. Davis. Published by Longmans, Green & Co., 91 Fifth Avenue, New York. Size, 6 x 9; pages, 110. Price, $2.

This work, which has been prepared by Lionel S. Marks, M.M.E., assistant professor of Mechanical Engineering at Harvard, and Harvey N. Davis, Ph.D., instructor in Physics at the same college, places before the reader the results of recent investigations along these lines.

The properties of superheated steam are tabulated for every pound pressure and for every ten degrees of super-

heat within a range which exceeds present practice. Supplementary tables extend the superheated steam tables to very high temperatures. Besides the tables there are two large diagrams showing the properties of saturated and superheated steam.

**Machine Drawing and Design for Beginners.**—By Henry J. Spooner, C.E. Longmans, Green & Co., 39 Paternoster Row, London, Eng.; 91 and 93 Fifth Avenue, New York. Pages, 266. Price, $1.25.

The book is edited as an introduction to the subject of Machine Design, and leads up to the study of the author's more advanced work, Machine Design, Construction and Drawing, and is intended to supply a long-felt need among evening students, during the first year or two of their work, who require a book easily carried about, and which is not too expensive.

The first six chapters are devoted to drawing, where such items as drawing instruments, printing, shading, straight-line drawing and working drawings are given consideration. Then follow several chapters on machine parts, such as stuffing boxes, journals, keys, riveted joints, machine and lever handles, principal joints, roller and ball bearings, engine parts, and many complete examples of working drawings.

A great number of examination papers are given with which the instructor should make himself familiar. There are a score of useful tables given and over one hundred set exercises.

One is a little surprised to note the small amount of attention given to printing, which is all important, but it is intended that the student get that elsewhere. The book goes very much ino detail, and gives very many illustrations. All lines are clear and legible, and suited for work with artificial light. This work would be of great assistance to the zealous but overloaded instructor and to the student who "wants to know." A. E. D.

**Automatic Block Signals and Signal Circuits,** apropos of American practice in the installation and maintenance of signals electrically controlled and operated by electric and other power, with descriptions of the accessories now regarded as standard. Author, Ralph Scott. Publishers, McGraw Publishing Co., New York City. Size, 6 x 9; pages, 243. Price, $2.50 net.

In character, the work is original. With commendable consideration for those who are not familiar with railway terms, the author has adopted a style which will be appreciated by all. Comparatively speaking, little has been written upon the art of railway signalling.

"Automatic Block Signals" is replete with information of inestimable value alike to the signal engineer, the railway engineer, the electrical engineer, and the railway man generally. Over two hundred illustrations and diagrams are given in the volume, which is devoted almost exclusively to railway signalling mechanism. Its scope does not permit of any reference to the history of signalling, and, although the author pretends to deal with American practice only, some comment upon the systems of other countries might have been included to advantage.

Chapter I. opens with definition of blocks and block signals, and gives a description of the various standard signals, the positions they occupy, the functions they perform, and their methods of operation. Simple circuits are illustrated and discussed in a practical manner in Chapter II., while the third chapter is devoted to normal danger circuits. The movements of trains are followed, and the different positions the signals assume are clearly shown. Chapter IV., entitled "Normal Clear Circuits," is somewhat similar in scope to Chapter III.

Fifteen pages constitute the fifth chapter, which contains a good description of semi-automatic circuits and signals and the parts they play in the operation of trains.

The batteries generally used in connection with electrically operated signals are dealt with in Chapter VI. The component parts of the Gravity, Gordon and Edison primary cells are touched upon, and their merits or demerits pointed out. Ten pages are devoted to a description of the track circuit, which includes that part of the control feature affected by the presence of a train. Both simple and comprehensive arrangements are referred to. This chapter also embraces an account of rail joints and rail bonds, while mention is made of a circuit-breaking device used in conjunction with a swing bridge.

Chapter VIII., comprising fifteen pages, is descriptive of controlled manual systems, which are still used extensively by many railways. The parts forming the system are treated separately.

The ninth chapter relates to motors, relays, etc.

Chapter X. tells of the apparatus, known as the disk signal, used on the Lehigh Valley and other American roads, and includes an interesting discourse upon the advantages and disadvantages this type of mechanism possesses. A description of Union apparatus and instruments comprises Chapter XI. Electro-pneumatic and electro-gas systems, used on many busy lines, are discussed in Chapter XII., while Chapters XIII. and XIV., upon the subjects of electric locking and all-electric interlocking are particularly interesting. Chapter XV. is devoted entirely to three-position signals.

Chapter XVI., on electric railway systems, is timely, in view of the developments constantly taking place. A section devoted to maintenance concludes a desirable addition to the literature on American railway signalling apparatus and practice.—W. M.

**Modern Methods of Sewage Disposal.**—By W. H. Trentham, M.I.M.E., and James Saunders, A.M.I.C.E. Published by the Sanitary Publishing Co., Limited, 5 Fester Lane, Fleet Street, London, E.C.

This publication is a condensed account of the leading features appertaining to sewage disposal works on the biological system. Instead of being termed "Modern Methods," a better term would have been "A Modern Method." The publication does not pretend to be technical, but, as the preface states: "The members of local authorities and their officials, who are, as a rule, active business men, usually have no time to study elaborate treatises when it is necessary for their boards to undertake the construction of such works, and we believe that the information given, based entirely on practical acquaintance with the subject, will prove of value in assisting them to decide which system of sewerage and sewage disposal should be adopted to meet the requirements of their particular town or district."

The authors here evidently assume that it is part of the duties of these gentlemen engaged in municipal business, along with their officials, to decide on the particular method of sewage disposal applicable to their district. We have always understood that this is particularly the business of the expert engineer only. We, however, certainly consider that the business men referred to will require a wider knowledge before being capable of making any determination on this subject than is supplied in the modest booklet before us. One-half page is devoted to the question of sedimentation, and two and a half pages to "Aërobic Treatment in State Beds" (W. I. Dibdin's system). We do not exactly know to which class of our readers to recommend this book, but if there are any who do not require any real or sufficient knowledge upon the sewage disposal problem, but think that a slight smattering and quick dip into the shallows of the subject would do them no harm, then to such we have pleasure in bringing this publication to notice.

Generally speaking, we feel a certain amount of diffidence in reviewing a publication which, on the face of it, is neither technical nor scientific, but, generally speaking, is simply an advertisement of the authors as consulting engineers. There is little doubt that the intention is not that the business men referred to shall be educated to the extent of being able to choose a system, but rather that with the assistance of the authors, whose practical experience receives notice, they may be able to arrive at a satisfactory choice. —T. A. M.

**Concrete Bridges and Structures.**—This book is handbook size, 4¼ by 6¼ inches, and contains 128 pages and 51

illustrations. It is printed on a fine quality of heavy glazed paper, with gilt edges, and bound in flexible black leather. Price, $2.50.

Part I. treats of concrete bridges for both highways and railroads. It gives in a concise form the most approved methods of design and construction, and puts the information in such a practical way that the busy engineer can easily apply the methods of design without spending valuable time in the perusal and study of obstruse mathematical treatises.

In this part there are about forty chapter headings, describing quite fully the methods of design, and an actual example of a 60-foot arch span is given, and the various steps in the design described in detail.

There is also a table giving the principal concrete arch bridges now in existence and building. Nine of these are described in detail, and are illustrated with half-tones and line drawings. Views are shown also of some old Roman bridges that are still existing, and dating back about two thousand years.

Part II. contains methods of design and construction for minor bridges and structures, including concrete trestles and culverts. It contains original tables giving upwards of nine hundred separate estimates for structures of various sizes, together with charts showing the relative costs of various forms. There are also about thirty full-page illustrations, showing structures of various designs, and these are accompanied with tables of sizes and estimated costs

Reinforced concrete beam and slab tables are given, showing the economic span length for each of the various combinations of slab and beam for use in bridge design.

The book may be purchased at all book stores, or from any of the engineering journals. For sale also by the author, H. G. Tyrrell, Evanston, Ill.

## PUBLICATIONS RECEIVED.

**Georgian Bay Ship Canal Report.**—The report for 1908 in two volumes accompanied by sixty plates and numerous photographs and maps. Pages, 600. Price, $4. Hon. Wm. Pugsley, Minister of Public Works; Eugene D. Lafleur, Chief Engineer, Ottawa, Ont.

**Sewage Disposal.**—A Report to the Council of North Toronto, Ont., dealing with the possibilities of connecting with the Toronto system and the cost of independent works. By T. Aird Murray, 612 Continental Life Building, Toronto. Size, 6 x 9. Page, 20. Price, 50 cents.

**Annual Report of the Minister of Mines** of British Columbia for the year ending 31st December, 1908, being an account of mining operations for gold, coal, etc., in the Province. William Fleet Robertson, Provincial Mineralogist. (British Columbia Bureau of Mines.) 271 p., plates, maps, 1908. Victoria, Government Printing Office, 1909.

**Report of the Mines Branch for 1908.**—Pages, 100. Size, 6 x 9. A summary report for last nine months of 1908. Hon. W. Templeman, Minister; A. P. Low, LL.D., Deputy Minister; Eugene Haanel, Ph.D., Director.

**Tables and Diagrams** of the Thermal Properties of Saturated and Superheated Steam, by Lionel S. Marks, M.M.E., and Harvey N. Davis, Ph. D., both of Harvard University. New York: Longmans, Green & Company, 91-93 Fifth Avenue.

## CATALOGUES.

**Belt Dressings.**—Belt dressings are dealt with at some length in a booklet just issued by the Joseph Dixon Crucible Co., of Jersey City, N.J. The first section is devoted to belts, and tells why they slip, while the next refers to dressings, good and bad, and gives directions for applying. In another portion, headed, "Hints, Kinks, Tables," much information of interest is given.

**Sewage Filters.**—Pacific Flush Tank Company, 184 La Salle Street, Chicago, Ill. The object of this book is to show the application of automatic apparatus to various types of bacterial sewage filters. Illustrations of the automatic apparatus with detailed dimensions are given. Also diagrams of sand filters, contact beds, and percolating filters. It is a very useful catalogue and engineers interested in sanitary matters should have a copy.

**Flush Tanks.** A catalogue issued by the Pacific Flush Tank Company, 184 La Salle Street, Chicago, Ill., will be found of great interest to all engaged in sanitary engineering. It contains diagrams, dimensions, and information in connection with the various flush tanks handled by this firm. It will be valuable for reference.

**Electric Smelting.** Large transformers for electric smelting, the details of construction, etc., are described in a booklet published by the Packard Electric Company, of St. Catharines, Ont. Numerous illustrations are given as well as a description of installations at Welland and Niagara Falls.

**Water Main Cleaners.**—The Whitney Pipe Cleaning Co., 220 Broadway, New York, are distributing a booklet which tells of their success in cleaning water mains. Their machines work in mains in sizes from 4 inches to 4 feet. The cost of operation is very small and the increase in efficiency very great.

**Automatic Sewage Appliances.** Messrs. Drummond, McCall & Company, Montreal, Canada, Canadian representatives of Mather and Platt, are distributing a booklet on the above subject. The booklet contains information as to arrangement of sewage plant and many diagrams and photos of completed works.

**Tungsten Lamps.**—In concise form, the Engineering Department of the National Electric Lamp Association present much information of interest to central station men, jobbers, dealers and consumers, upon the Carbon, Gem, Tantalum, and Tungsten incondescent lamps of many sizes. Address, 4411 Hough Avenue, Cleveland, Ohio.

**Steam Road Rollers.**—The Monarch Road Roller Co., 114 Liberty Street, New York, have issued a booklet descriptive of their road rollers. Diagrams illustrate the main dimensions and unusual features, while the illustrations show the various uses these machines may be put to, for besides road rolling they are traction engines, for graders, etc., and power engines for crushing plants. Wm. Eddie, corner Princess and James Street, Winnipeg, is their Canadian representative.

**Municipal Filtration.**—A booklet of unusual interest to municipal officials, sanitary engineers and medical health officers, as it is devoted almost exclusively to methods of water purification and filtration. Many illustrations are given of plants installed by the publishers, The Pittsburgh Filter Manufacturing Company, of Pittsburgh, Pa.

**Gas and Oil Engines.**—Dudbridge Gas, Oil and Spirit Engines and Gas Producing Plants of various types are illustrated and described in a booklet which is being distributed by A. H. Wright, 32 Church Street, Toronto, the Canadian representative of The Dudbridge Iron Works, of Stroud, Glos., England, a long-established and reputable firm. The engines described have many distinctive features.

**Engineers Supplies.**—E. R. Watts & Sons, 408 Portage Avenue, Winnipeg, and 200 Wellington Street, Ottawa, send out a catalogue of engineers', surveyors', architects' and draughtsmans' instruments and supplies. Besides giving a full list of goods with prices it has also chapters on the care and adjustment of instruments. Their shop at Winnipeg is prepared to repair any British or American instrument.

**Forge Blowers.**—Two catalogues have recently been published by the Buffalo Forge Company, Buffalo, N.Y. One will be of usual interest to blacksmiths, carriage and wagon manufactures. The increasing demand for electric forge blowers has prompted them to design a line of high efficiency blowers for serving forge fire. Bulletin No. 78C is entirely devoted to this line. The other catalogue No. DW Electric covers a new design exhaust fan of the disk type, this contains, in addition to cuts of the pulley and direct connected types, tables giving speeds, capacities and prices. This should be of interest to those needing ventilation in overheated quarters.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que.; Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. Prtsident, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secrttary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**National Irrigation Congress.**—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

**League of American Municipalities.**—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé, R.S.A.; P.O. Box 259, Montreal, Que.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Prince Edward Island.**

CHARLOTTETOWN.—Tenders will be received up to Monday, July 12th, for the construction of a 20 stall, brick and concrete engine house, foundation for turntable, foreman's office and lavatories. Plans may be seen at the Resident Engineer's Office, Charlottetown, at the office of the Chief Engineer, Moncton, N.B.. M. J. Butler, Chairman, Ottawa, Ont.

**Quebec.**

MONTREAL. — Tenders for macadamizing several streets and also the building of sewers will be received to the 9th instant at 6 p.m Plans and specifications to be seen at the Town Engineer's Office, 5 Beaver Hall Square Montreal. R. D. Dunn, secretary-treasurer town of St. Paul.

WESTMOUNT.—Tenders are invited for the construction of cement or granolithic sidewalks, to be filed not later than Friday, 9th July, at 5 p.m. A. D. Shibley, city clerk.

**Ontario.**

ALEXANDRIA.—Tenders for the erection of a new French Catholic Church will be received up to Thursday, 15th July. Tenders to be for rubble stone or cement blocks. Rev. J. W. Dulin.

BRAMPTON.—Tenders will be received until Saturday, 10th July, for the construction of 6,500 square yards of concrete walks, a concrete reinforced floor over a girder bridge, a 32-foot girder span across the Etobicoke River, and two concrete abutments for the above bridge. W. M. Treadgold, town engineer.

BRANTFORD.—Tenders will be received until noon, 10th July, for two horizontal multi-tubular boilers, required for the Institution for the Blind, and two horizontal multi-tubular boilers, required for the Normal School, Toronto. H. F. McNaughten, secretary Public Works Department, Toronto.

CALLENDER.—Tenders wanted for the erection of a cement block, two-storey school, having cement foundations; also for moving of present school. B. Shannon, secretary school board.

HICKSON.—Tenders will be received until Monday, July 12th, for the erection and completion of a Steel Bridge and Concrete abutments in the township of East Zorra, Oxford County. Length, 30 feet; width, 14 feet; height of abutments, probably 12 feet. Tenders to be for either beam or truss span and capable of carrying a cement floor and 20,000 lbs. load. Work to be completed on or before October 1st. James Anderson, clerk, East Zorra.

MOOSE CREEK.—Tenders will be received until July 12th for excavations for a drain. Estimated cost, $5,000. F. D. Brunet, Township Clerk.

NORTH BAY.—Tenders for Customs and Inland Revenue fittings will be received until Monday, July 12th, 1909. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received up to August 15 for the furnishing of iron posts for use on the survey of Dominion lands. P. G. Keyes, secretary, Department of the Interior.

OTTAWA.—Tenders will be received until Friday, July 23, for the construction of a building for refinery, Royal Mint. Napoleon Tessier, secretary, Department of Public Works.

OTTAWA.—Tenders will be received until July 15th for the supply of coal for the Public Buildings throughout the Dominion. Napoleon Tessier, Secretary, Department of Public Works.

PETERBOROUGH.—Tenders will be received up to Saturday, the 17th July, for the construction of abutments for the steel bridge over the Indian River. Plans and specification may be seen at the office of the County Engineer, J. E. Belcher. Ed. M. Elliott, County Clerk, Peterborough.

PETERBOROUGH.—Tenders will be received up to the 17th July for the steel work of a bridge over the Indian River, 75 feet span from abutments' faces at water level. County Engineer, J. E. Belcher. Ed. M. Elliott, county clerk.

PETERBOROUGH.—Tenders for the erection of Knox Church will be received up to Monday, July 19th. Secretary Building Committee, 283 Park Street.

TORONTO.—Tenders will be received until July 12th, for the construction of concrete storage and regulating dams near Port Arthur. H. F. McNaughten, Secretary, Department of Public Works. (Advertized in the Canadian Engineer.)

TORONTO.—Tenders will be received until Tuesday, July 13th, for the several works required for the enlargement of Harbord Street Collegiate. W. C. Wilkinson, secretary-treasurer, Board of Education.

WATERLOO.—Tenders will be received up to Monday, July 12th, for covering bridges with concrete. Ford S. Kumpf, town clerk.

**Manitoba.**

BRANDON.—Tenders will be received up to July 17th for a supply of creosote wood paving blocks for bridge paving. Price to be per yard f.o.b. Brandon, duty paid. Harry Brown, city clerk.

WINNIPEG.—Tenders will be received until August 2nd and August 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chace, engineers, Winnipeg; William Kennedy, jr., Y. M. C. A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

WINNIPEG.—Tenders will be received up till July 12 for all of the works required in connection with the erection of a brick and concrete warehouse building at Calgary. J. H. G. Russell, architect.

**Saskatchewan.**

MOOSE JAW.—Tenders will be received up to Monday, 18th July:—1-50 light, constant current transformer or regulator, with 35 arc lamps and suitable switchboard, with necessary instruments for controlling same; one year's supply of Watt meters; one' year's supply of transformers. John D. Simpson, City Clerk.

REGINA.—Tenders will be received until July 19th, for a supply of sewer pipe. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for concrete pavements, curbs, and sidewalks. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for a supply of pipes and valves for waterworks system. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received up to Monday, July 19th, for the erection of a hospital. J. Kelso Hunter, city clerk.

REGINA.—Tenders will be received up to Thursday, July 15, for the supply and delivery of coal, 1909-10, for the

Royal North-West Mounted Police. R. S. Knight, inspector, supply officer.

YORKTON.—Tenders will be received up till July 12 for the erection of a concrete and brick business block for the Enterprise Publishing Company. T. A. Patrick, M.D., secretary.

YORKTON.—Tenders will be received until Monday, July 19, for a heating system. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**British Columbia.**

VANCOUVER.—Tenders will be received up till noon, July 12th, for the whole or part of the construction of Sections 3 and 4 of the Fraser Valley branch of the British Columbia Electric Railway Company, Ltd. Charles Garden, Engineering Department, British Columbia Electric Railway Company, Ltd.

VICTORIA.—Tenders will be received up to Monday, 16 August, for the supplying of cast iron water pipe, pig lead, gate valves, for waterworks. W. W. Northcott, Purchasing Agent.

## CONTRACTS AWARDED.

**Nova Scotia.**

HALIFAX.—S. Cunard & Company were the lowest tenderers for all the city coal contracts for 1909 excepting that for 400 tons of Pictou nut on which H. D. McKenzie & Company, figured lowest, and the committee recommend the contracts be awarded to Cunard & Company, and McKenzie & Company. The prices were all for the "long" ton of 2,240 pounds. The quantities and prices at which the contracts were awarded were as follows:—City Health Board—4 tons anthracite and 16 tons bituminous; Cunard & Company, anthracite at $7.15 and Old Sydney at $5.40. City Prison—90 tons Sydney at $5.40, and 15 tons anthracite at $7.10, Cunard & Company. City Home—400 tons Pictou nut at $4.20; McKenzie & Company, 25 tons egg anthracite at $6.95, Cunard & Company. Fire Department—25 tons Acadia lump at $5.45, 133 tons Sydney at $5.40, 6 tons Albion slack at $4.75, 105 tons anthracite at $7.20, S. Cunard & Company. Public Gardens—40 tons Acadia nut at $4.65, 8 tons Sydney at $5.20, 8 tons anthracite at $6.25, S. Cunard & Company. City Works Department—140 tons anthracite at $6.95 and 13 tons Sydney, for the City Hall, at $5.20; 15 tons Acadia lump for the steam roller, at $5.30; 40 tons Acadia nut, for the crusher, at $4.30; 23 tons lump, for the steam drill, at $5.20; 11 tons bituminous for stables and workshop; 12 tons Albion slack for the blacksmith shop, at $4.75, and 7 tons anthracite for the stockyard, at $7.25, Cunard & Company.

**New Brunswick.**

MONCTON.—For 3,800 lbs. of No. 4 W.P. wire for transmission lines in connection with the new electric plant. the city received the following tenders:—

| | |
|---|---|
| * Wire & Cable Company, f.o.b. Moncton.. | $613.70 |
| Canada General Electric Company ..... | 630.80 |
| Sumner Company, f.o.b. Moncton ..... | 638.40 |

* Accepted

Tenders were also received for special castings for the new pumps, embracing 18 inch, 14 inch and 12 inch T's and bends, also a few lengths of 14 inch, and 18 inch pipes, and were as follows: Canada Iron Corporation Company, Londonderry, $399.51 f.o.b. cars, Moncton; Canada Foundry Company, Halifax, $554 f.o.b. cars, Moncton. The tender of the Canada Iron Corporation Company, Ltd., was accepted.

In connection with steam and electric plant, City Engineer Edington recommended the following tenders: Canada General Electric Company, generator, $6,470; Robb Engineering Company, engine, $5,448, and boiler, $1,040. These were accepted.

**Quebec.**

MONTREAL.—Westmount Council met recently regarding contracts for street paving. The Bitulithic & Paving Company's tender for asphalt and scoria combination paving on St. Catherine Street, from Atwater Avenue to Greene Avenue, and Greene Avenue, from Dorchester Street to Sherbrooke Street, at $36,658, and the Barber Asphalt Company's tender for paving Dorchester Street and Greene Avenue to St. Catherine Street, from Atwater Avenue to Hallowell Street, with asphalt, for $18,459.76, were accepted. The Bitulithic & Paving Company was also successful in its tender for paving Victoria Avenue from St. Catherine Street to Sherbrooke Street, with combination pavement, gutter and curb, for $28,627.

MONTREAL.—At the last meeting of the Council of Outremont tenders for the construction of the sewer on St. Catherines Road were opened and the contract was awarded to Messrs. Gilbert, Toussaint & Company, they being the lowest tenderer, at $7.90 per running yard, and $3.10 for rock excavation per cubic yard extra.

MONTREAL.—A contract for cement sidewalks has been given to the Modern Paving Company at $2.22 a yard. The E.D. Hofeller Company offered to do the work at $1.86 a yard.

**Ontario.**

BERLIN.—Aug. May has received the contract for cement curb and gutter. The following tenders were submitted:—

| | Curb and Gutter | Driveways |
|---|---|---|
| Aug. May, Berlin ..... | 35c. | 11c. |
| P. Bergmann, Waterloo ..... | 45c. | 12½c. |
| John Conn, Windsor ..... | 66c. | 14c. |

BLENHEIM.—A contract for the tank and pumping station at the power house has been given to J. H. Collier and D. H. Grady at $500. Clunis & McIntyre will install a gas engine to pump two thousand gallons an hour for $173.

KINGSTON.—E. B. Merrill, civil engineer, of Toronto, has secured the contract for reconstructing the gas tank here at $4,300.

OTTAWA.—The contract for building the new G.T.R. Central Station has been awarded to Peter Lyall & Sons, of Montreal, and work will be started immediately. The station will cost $500,000.

**Ontario.**

ST. CATHARINES.—The Council received the following tenders for 2-inch pipe: A. Moore, f.o.b. Montreal, $13.50; Watts & Bate, f.o.b. St. Catharines, $14; S. P. Gourlay, f.o.b. St. Catharines, $13.25; Coy Bros., f.o.b. St. Catharines, $14.95. Mr. S. P Gourlay's tender was accepted.

ST. THOMAS.—Hamilton & Stott have been given a contract for a heating system, by the city council, at $2,668. The American Steel Company, of Lockport, N.Y., bid $1,960 and $1,485, which did not include freight or duty.

ST. THOMAS.—Tenders for work on the Grace Methodist church were let as follows:—Sanders & Bell, carpenter work, $8,484; A. E. Ponsford, masonry and brickwork, $9,836; Celeste Blonde, Chatham, plastering, $1,575; Sandham & Roberts, electric wiring, $119.

TORONTO.—The Board of Control recently opened tenders for laying between 350,000 and 450,000 duct feet of underground conduit. The bulk tenders of twelve contractors were as follows: $55,801; $60,466; $60,622; $62,631; $66,766; $71,205; $72,275; $77,403; $77,578; $77,890; $83,336; $99,368. The lowest tenderers, Golden & Lansing, of Troy, N.Y., will be given the contract if the city engineer approves.

TORONTO.—The contract for cedar culverts on section one of the Soo-Sudbury trunk wagon road was awarded by the Public Works Department to D. McNaughton, of Sudbury. This section runs from Copper Cliff to Naughton.

TORONTO.—The Connell Anthracite Coal Mining Company have been given an order by the Board of Education for 4,000 tons of semi-bituminous coal at $5.15 for grate and $5.30 for egg, stove and nut.

TORONTO.—George M. Hendry & Company have been awarded a contract for chemical apparatus ($264,341), and for physical apparatus ($4,053) for th ehigh schools.

PETERBOROUGH.—For the erection of new library here the tenders were as follows:—

| | |
|---|---|
| James Bogue | $22,080 |
| Malcolm McIntyre | 22,150 |
| R. Sheehy | 26,194 |
| W. J. and G. H. Baptie | 24,000 |
| Rutherford Bros. | 21,887 |
| J. G. Hayes | 22,450 |
| H. Carveth | 33,000 |
| W. J. Johnston | 23,500 |

Rutherford Bros. got the contract.

**Saskatchewan.**

MOOSE JAW.—Three tenders were received for the work of grading for the spur track to the power house and for putting new guy wires to the smoke stack. The contract was let to the lowest tenderer, Riddell & Cline, at the rate of 30 cents per cubic yard for the grading and $120 for placing the new guy wires.

**British Columbia.**

VANCOUVER.—The tender of Cameron & Company for the grading of Harris Street to Victoria Drive at $3,973 was accepted.

VANCOUVER.—The works department will lay a wood block pavement on Cambie Street, 41 feet wide, on a 6-inch concrete foundation with concrete curbs. Estimated cost, $42,130; contract price, $33,704. The Robson Street pavement will cost $6,570; contract price $5,256. It is 42 feet wide. Approximate cost per foot frontage: Cambie Street, $7.01; Robson Street, $7.27 1-5.

VICTORIA.—Some tenders for pavement work were: H. E. Canova, $16,000; Steven, Sabine & Steadham, $16,045.

**Foreign.**

PHILADELPHIA (PENN.).—The Raymond Concrete Pile Company, of New York, has been awarded the contract for placing Raymond concrete piles in the foundations of the cold storage building that will be erected for the Philadelphia Warehousing and Cold Storage Company at Front and Noble Streets, Philadelphia. Fifty thousand feet of Raymond concrete piling will be used in the work. Cramp & Company are the general contractors.

## RAILWAYS—STEAM AND ELECTRIC.

**Ontario.**

BERLIN.—The surveyors for the People's Railway are at work. On Monday last Mr. Warfield, construction engineer, and party of surveyors started on the route of the proposed railway, between New Hamburg and Stratford via Tavistock. Mr. H. Stuart, of Mitchell, Ont., Provincial Land Surveyor, Mr. J. H. Wood, of Hereford, England, draughtsman, and Messrs. Kerr and Kropf are among the party.

OTTAWA.—The contract for the new Grand Trunk depot at Ottawa has been awarded to Messrs. Peter Lyall & Sons of Montreal. The new station will be on the site of the present Central Depot, by the side of the Rideau Canal, but will be of much greater dimensions. It is to be 140 feet in width and 228 feet in depth. It will be four storeys in height and will be connected with the hotel on Major's Hill Park by a well ventilated and well lighted subway. It is proposed to make this station one of the largest and most complete in Canada, and the contract price will run into the millions.

OTTAWA.—The C.N.R. has filed for approval a route map in connection with its line through the suburbs of this city.

OTTAWA.—Hon. George P. Graham, Minister of Railways, has now signed the route maps of railway extensions in Alberta, to which he gave his verbal approval a week ago, and the following details are now available. The routes approved are: Canadian Pacific, line from Langden to a point forty-five miles north, and then to a point on their own line between Penhole and Red Deer; and of Canadian Northern from Strathcona south-west, crossing the Calgary and Edmonton line just north of Red Deer, passing near the same and south to Calgary; and also of the G.T.P. from Riley on the main line southerly to near Pound Hill, through Camrose, passing near, but west of Content and close to Three Hills, and south to Calgary. The Canadian Northern route map through Camrose was withdrawn.

SARNIA.—It is believed here, from the surveying that has been going on lately, that the G.T.R. are contemplating another tunnel to connect with Port Huron. The present one is too small.

TORONTO.—The Grand Trunk will commence operations on their old belt line round the city about the first week in October. It will be used chiefly for handling freight to and from the north end.

TORONTO.—The C.P.R. is working a transformation at Victoria Harbor, having a line of railway in operation for the construction purposes only. They are carrying on construction of immense docks and an elevator. The new million dollar elevator is in the preliminary stages yet, the concrete foundations being under construction. The Government dredges are working at the harbor.

**Manitoba.**

WINNIPEG.—Relative to the McPhillips Street subway which is to cost $360,000, the city to pay one third, the contract between the city and the C.P.R. has been shaped.

WINNIPEG.—Within the next three weeks the C.N.R. will begin work 120 miles south of Camrose, and construction camps will be strung out all along the line. Two hundred miles of the Vegreville to Camrose to Calgary branch will also be constructed this summer.

**Saskatchewan.**

CARLYLE.—The gang which will do the grading work on the C.N.R. Maryfield-Lethbridge line arrived here some days ago.

ESTEVAN.—A party of Grand Trunk Pacific surveyors has been working east of this town on a proposed line from Regina to Portal.

SASKATOON.—By a ruling of the Railway Commission the plans of the city regarding the subway under the C.N.R. tracks from east to west have been approved. By this decision the railway company will have to pay some $20,000 towards the cost of the subway. This subway will be built at Twenty-Second Avenue, and as the company has declared its intention to construct thirteen additional tracks at this point it will be seen that the subway will be a mammoth affair, unless the railway company decide to carry the yards further north.

**Alberta.**

CALGARY.—A new era in this city dates from this week, when the first section of the street railway was opened. This runs from First Street to the Fair grounds. The City Council, with a party of prominent citizens, made the initial run. A five-minute service is given.

HIGH RIVER.—A construction gang of the C.P.R. is busily engaged laying two more tracks and extending the yards away south of the Little Bow River. Three cement bridges will be built across the Little Bow.

**British Columbia.**

VANCOUVER.—Plans submitted by the British Columbia Electric Railway for extensions in Vancouver have been approved.

VICTORIA.—The British Columbia Electric Railway Company is erecting a power house and installing new plant at Victoria. Malcolm & Dinsdale have the contract.

**England.**

LONDON.—The G.T.R. has opened new offices in Cockspur Street.

## CEMENT—CONCRETE.

**Nova Scotia.**

SYDNEY.—The annual meeting of the Sydney Cement Company, Limited, will be held on Monday, July 12th, at 11 a.m., in the company's office here.

**Quebec.**

MONTREAL.—Cement sidewalks for this municipality will be laid by the Modern Paving Company at $2.22 a yard.

WESTMOUNT.—Tenders for sidewalks of cement will be opened by A. B. Shibley, city clerk, this week.

**Ontario.**

ALEXANDRIA.—Rev. J. W. Dulin invites tenders until July 15th for the construction of a church of cement blocks or rubble stone.

BELLWOOD.—On July 2nd Mr. T. Goodall opened tenders for concrete abutments for a bridge which will be erected by the West Garafraxa Council.

BERLIN.—A contract for cement curb and gutter work has been given to Aug. May, of Berlin, by this town.

BRAMPTON.—In our list of tenders, on another page, appears a memo. of the work to be done in Brampton, including concrete walks and bridges. The town engineer is W. M. Treadgold.

BURFORD.—Mr. Wm. Shaver has been awarded the contract for laying 7,000 feet of cement walk in the village.

CALLENDER.—A cement block school, two storeys high, will shortly be erected here by the school board. B. Shannon will receive tenders.

HICKSON P.O.—James Anderson, clerk of the township of East Zorra, Oxford County, asks for tenders for a bridge with concrete abutments until Monday, July 12th.

KINGSTON.—The Board of Works are purchasing two mixers from the London Concrete Machinery Company. Concrete will be used in the reconstruction of the gas tank, a contract for which has just been given to E. B. Merrill, of Toronto.

LONDON.—Much cement is being used on the streets of London in walks, curbs, gutters and other improvements.

PETERBOROUGH.—Until July 17th, plans for abutments for a steel bridge over the Indian River, may be seen at office of J. E. Belcher, county engineer.

PETERBOROUGH.—Plans for a concrete bridge, to cost $32,500, have been outlined by the city officials, and the ratepayers will decide on July 20th whether the work is to be carried out. It is expected that the by-law will carry.

WATERLOO.—For covering bridges with concrete, F. S. Kumpf asks for tenders until July 12th.

**Saskatchewan.**

YORKTON.—The Enterprise Publishing Company are asking for tenders for a concrete and brick business block.

**Alberta.**

CALGARY.—Hodgson & Bate, architects, are calling for tenders for a brick and concrete warehouse.

## FINANCING PUBLIC WORKS.

**Nova Scotia.**

ANTIGONISH.—D. C. Chisholm, town treasurer, asks for tenders for $8,000 debentures.

**Quebec.**

VERDUN.—A meeting will be held on Friday, the 9th instant., for the purpose of discussing By-law No. 111, respecting the issue of debentures for $150,000. Geo. A. Ward, secretary-treasurer.

**Ontario.**

BELLEVILLE.—A by-law to raise $70,000 for three new schools was defeated.

BERLIN.—The Provincial Public Works Department have approved of the by-law to cover the cost of contemplated road improvements and will contribute one-third.

BERLIN.—The by-law covering an expenditure of $19,000 for double-tracking the street railway carried by 37.

BROCKVILLE.—At a special session of the Council of Leeds and Grenville, on July 6, it was decided to introduce a by-law at he Nov. session to raise $200,000 by debentures for the improvement of the roads of the counties. A Government grant under the Good Roads Act of $100,000 is expected to supplement the amount decided upon to-day.

LONDON.—On July 26th the ratepayers will vote on a by-law to provide $95,000 for waterworks.

OTTAWA.—An issue of debentures amounting to $419,000, for local improvements, has been authorized by the Board of Control.

PETERBOROUGH.—Peterborough ratepayers will on July 29th, vote on two by-laws, both of which were defeated at the municipal elections last January. The ratepayers did not have sufficient information regarding the measures at that time, but it is expected that they will have a better fate this time. The present Smith Street Bridge By-law is for $32,500, and the street extension proposition is for $21,500.

PETROLEA.—The by-law of $4,000 for a bridge carried.

SEAFORTH.—A by-law to raise $20,000 for steel and concrete bridges will be voted on by County of Huron ratepayers shortly.

WELLAND.—Welland citizens by 303 to 9 carried a by-law to permit the Provincial Natural Gas Company to pipe the town for natural gas.

**Manitoba.**

PORTAGE LA PRAIRIE.—Waterworks and sewerage debentures, amounting to $50,000, will be placed on the market by this city.

**Saskatchewan.**

ROSTHERN.—A by-law to provide $6,000 for the purchase of fire protection system, including a gasoline fire engine and underground cement tanks, was defeated.

SASKATOON.—Messrs. Wood Gundy & Company, of Toronto, have purchased $184,800 city of Saskatoon debentures, which were issued for the erection of a collegiate institute and municipal buildings, extension of power plant, parks and roads.

**British Columbia.**

EBURNE.—The corporation of Point Grey invites tenders for $280,000 road debentures and for $28,000 school debentures. Herbert Beeman, Clerk.

## SEWERAGE AND WATERWORKS.

**Ontario.**

LONDON.—A million gallons of water from the artesian wells sunk by Hon. Adam Beck to prevent a shortage again this summer, was turned into the city main. The by-law to take in the whole scheme of the wells will be put before the ratepayers on July 26.

NEWMARKET.—J. Harvey, of Greensville, Ont., is boring a well here for the Davis Leather Company.

PETERBORO'.—Six carloads of machinery and tools of the Bishop Construction Company, of Montreal, have arrived in the city and will be used in the work done by this company at the new waterworks dam.

RICHMOND HILL.—Mr. Frank Barber, York County engineer, is preparing a report which will deal with the possibilities of a gravitation water system for this municipality.

**Manitoba.**

DAUPHIN.—A delegation from Dauphin recently paid a visit to the new compressed air waterworks system at Yorkton, Sask., with a view to installing a similar system here.

PORTAGE LA PRAIRIE.—Several extensions of the water and sewerage system have been ordered by the City Council here.

**British Columbia.**

VANCOUVER.—On the recommendation of City Engineer Clement, the Board of Works decided to proceed with the construction of city sewers to cost in the neighborhood of $75,000.

VICTORIA.—An option has been made to the Oak Bay Council by the Esquimalt Waterworks Company. The company offers to supply water at the same rate as that prevailing in this city at six cents a thousand gallons. The present supply is obtained through the city of Victoria at a flat rate of 18 cents per thousand gallons. The option was accepted.

## CURRENT NEWS.

**Ontario**

DELHI.—The unexpected striking of natural gas here has been realized. After continuous drilling on the Strout farm, Mr. Strout and Henry Darby have reached gas and oil at a depth of 1,220 feet.

OTTAWA.—A question of general interest to come up before the Dominion Railway Board shortly, concerns the location of switch stands in railway yards. The complaint is that they are often too near the tracks, thus endangering the lives of employees.

OTTAWA.—The Department of Inland Revenue announces that it is prepared to receive electrical instruments for examination or testing at its electrical standardizing laboratory at Ottawa. A scale of fees is published in the Canada Gazette.

OTTAWA.—Another electric smelting plant has been established at Trollhatten Falls, Sweden, and is operated under conditions similar to those existing in Canada. Dr. Haanel is enthusiastic regarding the possibilities of the installation of a plant in Canada.

**Manitoba.**

WINNIPEG.—The plant of the Manitoba Gypsum Company was destroyed by fire on July 3rd, entailing a loss of $60,000, well covered by insurance.

**Alberta.**

LETHBRIDGE.—A special party is being placed in the field for the purpose of taking stream measurements on the St. Mary's and Milk Rivers and their tributaries in Canada with a view to determining more accurately the quantity of water for irrigation and other purposes in each stream. The work will be done under the direction of P. M. Sauder, of Calgary, and the engineer in charge of this part will be D. J. Peters, of London, Ont., who has had some previous experience in this kind of work in connection with the Georgian Bay Ship Canal. The outfitting of the party is being done here now, and they will start work from Lethbridge early in July.

## TELEPHONY.

**Ontario.**

BROCKVILLE.—At a meeting of representatives of rural telephone companies operating in Leeds and Grenville, held at Athens, it was decided to establish an independent switchboard there that would unite all the various lines.

HENSALL.—A. G. Smilie, clerk of this municipality, invites tenders for a hundred miles of line and some two hundred instruments.

**Saskatchewan.**

CUPAR.—A meeting was held here recently to form a telephone company, and steps toward this end are already afoot.

## MISCELLANEOUS.

**Ontario.**

OTTAWA.—Aqueduct, paving and drainage work to be done by this city will involve an expenditure of half a million.

PORT ARTHUR.—Hon. W. Pugsley, Minister of Public Works, performed the ceremony of turning the first sod for the big dry dock and shipbuilding plant to be established here by stockholders of the American Shipbuilding Company. It is practically promised than an extension of the breakwater will be made to cover the proposed plant which will be big enough to accommodate the largest ships on the lakes.

TORONTO.—The resident Government Engineer, J. G. Sing, has received instructions to proceed with the work of construction on the superstructure of the northerly 1,600 feet of the west pier of the eastern channel. The Government has reserved and strengthened a portion of the land breakwater, and the contractor has resumed work on the 1,500 feet westerly. When these improvements including the new western gap are completed the Government will have spent $614,000.

**Manitoba.**

ST BONIFACE.—The Council have decided to recommend the spending of $75,000 on bitulithic pavement at once.

## LIGHT, HEAT, AND POWER

**Ontario.**

SARNIA.—The town voted for the extension of the gas franchise to the Sarnia Gas and Electric Light Company for twenty years. The Sarnia Gas Company have a contract to pipe gas from the Tilbury field and sell it for 14 cents per thousand feet for manufacturing purposes and 30 cents for domestic use.

**British Columbia.**

FERNIE.—The City Council of Fernie is negotiating for a new site for the electric light and power station.

## PERSONAL.

JAMES STOTT, Inspector of Electricity for Alberta and Saskatchewan, has been transferred to Vancouver as Inspector of Gas and Electricity for that district.

PROFESSORS F. D. ADAMS, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha James and J. B. Tyrell, have been elected as Canadian Members of Council of the Institute of Mining and Metallurgy of Great Britain.

Mr. F. JOHN BELL, of Montreal, has been appointed General Manager of the Mines Power Limited, Cobalt, Ont. The company are building a 10,000 horse-power hydro-electric plant for supplying power to the various mines in the Cobalt camp.

MR. HUGH D. LUMSDEN, who has resigned as chief engineer of the National Transcontinental Railway, was elected a Member of the English Institute of Civil Engineers in 1885, and has had a long and varied experience in railway construction work, being engineer in charge of the location of the northerly portion of the Toronto and Nipissing Railway under Edmund Wragge in 1870. Since that year his services have been in constant demand. He had charge of surveys on the Northern Railway, on the Credit Valley Railway, on the Georgian Bay branch of the C.P.R., and on the C.P.R. main line, including surveys in the Crow's Nest Pass and the Rocky Mountains, and was chief engineer on the location and construction of the Ontario and Quebec Railway from Toronto to Perth (107 miles) on the C.P.R. between Smith's Falls and Vaudreuil (104 miles), on the railway between St. John's and Lennoxville, and from Hobel to Mattawamkey, in Maine (120 miles), and was supervising engineer on the Qu'Appelle, Long Lake and Saskatchewan, and Calgary and Edmonton Railways, a distance of 524 miles. Mr. Lumsden is one of the foremost of Canadian Civil Engineers, and his judgment in railway matters is usually sound and practical. It would be a difficult matter to tabulate all the different works on which Mr. H. D. Lumsden, C.E., the acting chief engineer for the construction of the N.T.R. lines since its inception has been engaged. For the last thirty-five years he has been actively at work on Canadian railways and has had part either as Government expert or as consulting engineer in the locating or construction of all the more important roads which have been built during that time. He is an Englishman by birth, and was educated at Belhelvie Academy and Wimbledon School. He came to Canada in 1861 and since that time has attained a leading position in his profession. On several occasions he has been chosen on the council of the Canadian Society of Civil Engineers, and in 1906 was elected president of the society.

MR. W. SCOTT BROOKE, C.E., has been appointed town engineer of North Toronto, Ont.

MR. ELMER JONES, formerly of the Toronto Construction Company, has entered the employ of the J. D. McArthur Company. He will be engaged on the construction of the main feeder of the Southern Alberta Irrigation Company at High River, Alta.

MR. R. T. MACKEEN, formerly connected with the Canadian General Electric Company in the sales and engineering departments, has become associated with the Canadian Fairbanks Company, Ltd., in connection with their electrical interests.

MR. H. A. BAYFIELD has been appointed superintendent of dredges in British Columbia, a new federal post. Mr. Bayfield graduated in mechanical engineering from McGill University in 1896, and began his carrer in railway work with the Intercolonial and Great Northern Railways. He was superintendent of shops on the Great Northern, and after that was for three years mechanical superintendent of the Montreal harbor works before going West. On his arrival in Vancouver he was for two years mechanical superintendent with the British Columbia General Contract Company, and for the last five years he has been in private practice as a member of the firm of Bayfield & Archibald.

## MARKET CONDITIONS.

Toronto, July 8th, 1909.

Merchants in lumber, in metals, hardware, and other merchandise tell us that they are doing a steady moderate business, with no rush. But the way things are shaping in Ontario country districts, and with the favorable crop prospect here and in the West, they expect a big trade in September and October. Railway earnings continue good, increased over last year indeed, and bank clearings show increase; but the Sydney coal strike may prove a serious matter for the eastern end of the Dominion.

There is a curious quietude in metals, pig-iron has been in increasing supply—especially Cleveland—for some time, and the manufactured iron trade in Britain unsatisfactory. But there is a slight improvement there in structural steel. Taking the four metals, tin, copper, lead, and zinc, there is hardly a penny difference in the price of the first three on July 6th and May 6th; they are all low in price, and yet buyers seem afraid, from no definite reason, to "go in."

Revival of trade in the United States is but slow, in spite of continued efforts to make it appear that a boom exists. An able New York commentator puts the matter thus:—"Powerful interests have determined to ignore the slow revival in trade, and to re-establish and force advance of prices in excess of actual conditions and actual prospects. * * * * We have, indeed, two months holiday dullness before us, but the autumn prospect is excellent."

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. The spring rush is over and business steady.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth, delivered, $18; at works, $17 per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—The supply is far beyond the demand, and every maker seems to have his storage capacity occupied to the full. There is no reason, therefore, to look for any immediate change in the present quotation of $1.70 per barrel, including bags, or $1.30 without bags, car lots; for smaller quantities $1.40 to $1.50 per barrel in load lots delivered in town and bags extra. In paper packages, price would be, including paper bags, $1.40 to $1.50.

**Coal.**—Pennsylvania hard coal the retail price in Toronto is $6.50, with a strong likelihood of its continuing at this price for a month or two, the operators appearing to have agreed for a while. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $4.25 to $5.50.

**Copper Ingot.**—Unchanged and quiet at $13.85 to $14.05 per 100 lbs. Demand abroad not commensurate with real values at present prices.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

FLEUR DE LIS

"FLEUR DE LIS"
Galvanized Iron

Will work as well as "Queen's Head." Not so heavily coated.

JOHN LYSAGHT, LTD. Makers, Bristol.
A. C. LESLIE & CO., LTD. Montreal. 6

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is rather weaker, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—Considerable demand for both Southern and Canadian dimension pine continues; hemlock dull. Prices are rather stiff all along the line. Dressing pine quotes $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar quotes $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—In moderate request at prices per catalogue. It is impracticable to quote figures, so great is the variety of this kind of goods, but prices are steady.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Not much moving; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $42.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—Prices steady and demand good. The price continues at 31c. to 31½c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $31.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

* * * *

Montreal, July 7th, 1909.

The pig-iron markets of the United States continue to show firmness, although there is little, if any advance. As a matter of fact, several furnaces are asking 25c. more than a week ago, but it is very doubtful if

# The Canadian Engineer

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## The Canadian Engineer

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CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. JAMES, B.A. Sc.
**Business Manager**—JAMES J. SALMOND

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| Three Months - | 0.75 | Three Months - | 1.00 |

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**HEAD OFFICE: 62 Church Street, and Court Street, Toronto.** TELEPHONE, Main 7404.

**Montreal Office:** B33, Board of Trade Building. T. C. Allum, Business and Editorial Representative, Phone M 1001.

**Winnipeg Office:** Room 315, Nanton Building. Phone 8148. G. W. Goodall Business and Editorial Representative.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

**NOTICE TO ADVERTISERS**

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

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TORONTO, CANADA, JULY 16, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## MUNICIPAL OWNERSHIP.

Canada is just now on the crest of a wave of public and municipal ownership. The National Transcontinental Railway, the Ontario Hydro-Electric power line, and the hundred and one municipal lighting and street railway lines all indicate the general interest in this method of control, and go to strengthen the belief that municipal ownership is here to stay.

Municipal ownership has many advantages, but it has one or two great disadvantages, and perhaps the greatest is the number of indifferent employees such a system keeps on the pay-roll. The method of promotion, system of payment and control make men time-servers, and do not encourage that resourcefulness nor interest which one meets with among the employees of private corporations. The older a municipal-operated plant becomes the more inefficient workers you will find on the pay-roll. The ratepayer is in many instances finding municipal-controlled enterprises a distinct disadvantage.

Not only is this becoming true because of the inefficient employees on the pay-roll, but also because of the system of bookkeeping employed.

The board or committee having charge of such undertakings are up for election annually. Among the electorate are a large number of their own employees, and frequently their vote is organized and directed with a view of electing a friend of the employer instead of the community.

Then, again, alderman or councillor must keep the tax rate down, and many items that should be charged to current account are placed in capital account, and the general tax pays many bills that should be charged to special accounts.

Our present system of municipal bookkeeping and municipal management is not the best friend of municipal ownership.

## PROFESSIONAL ADVERTISING.

In Great Britain the etiquette of the engineering profession and the regulations of some engineering societies are opposed to engineers advertising by inserting cards in technical or class papers.

This may be a very proper stand to take, but we venture the opinion that it will not be long before British engineers follow the business methods of the professional man in other countries. The British engineer, instead of using the professional card in the technical press or daily paper, keeps himself before the public and the profession by their published expert reports, addresses and papers before societies and institutes, and even by having their social and domestic affairs reported in the social columns.

To these leaders cold-blooded advertising would bring little return—therefore they make it non-professional.

To the younger man, advertising by the line or inch would bring returns. It would place him on a more equal footing with the older practitioner. As it is now, in the Old Land, he must wait for some lucky moment when he is called as a witness in some large law suit or arbitration, or, as a junior, becomes associated, on a report, with a senior in the profession.

Restricted business-like advertising would be more profitable, honest and professionable than the present method of devising means and expedients to avoid the unwritten law in this matter.

## PIG-IRON BY MEANS OF ELECTRICITY.

Some recent experiments at the Domnarfvet Iron Works, Sweden, are of considerable interest in that they show the practicability of smelting iron by the aid of electric current.

The electric current, three-phase alternating was conducted to the furnace through electrodes of carbon, passing to the cylinder-shaped part of the furnace through the arch, which is cooled by means of water. The pressure during the experiments has been about 40 volts, with about 8,000 to 9,500 amperes, and the load 480 to 500 kilowatts. In order to protect the arch of the furnace against the high temperatures, furnace gas, which was obtained from the upper part of the furnace, was brought down under the arch through three openings by which a cooling effect was obtained.

The furnace was started and worked in the same way as an ordinary blast furnace. The charge used at present was of a weight of about two cwts. of ore from the Grangesberg iron mines (containing about 60 per cent. of iron), seven pounds of slaked lime, and 40 pounds of coke. According to an estimate made, this was equal to a consumption of five cwts. 3 quarters of coke per ton of pig-iron. The coke which was utilized contains 81 per cent. of carbon, 7 per cent. of water, and 11 per cent. of ash.

In a previous case an experiment was made with a charge, containing two cwts. of ore, 39 pounds of coke, and four pounds of lime, which was equal to about five cwts. two quarters of coke per ton of pig-iron.

In the products obtained, in some cases, the percentage of carbon was as low as that of steel. This was not the rule, however.

In these experiments the carbon content averaged about 1.80 per cent. The content of silicon varies from 0.2 to 0.07 per cent. The content of sulphur in grey pig-iron has been reduced to 0.005 per cent, while the content of sulphur in the coke used was about 0.5 per cent.

The quantity of electric power used is one of the most important matters in the question. No definite results have been secured, but the average of the more favorable runs has been something above two tons per electric horse-power year. With larger furnaces they expect to be able to secure three tons per electric horse-power year.

## EDITORIAL NOTES.

The prosperity and happiness of our country depends upon the quality of scientific technical training of those who guide our industries and control our trade.

* * * *

In the fiscal year ending March 31st, 1909, there was a decrease of $330,555 in amount of iron and steel bounties paid. The statement in detail is as follows:—

| | 1907-8. | 1908-9. |
|---|---|---|
| Pig iron | $ 863,816 | $693,423 |
| Steel | 1,092,200 | 838,100 |
| Wire rods | 347,134 | 333,090 |

In 1908-9 the production of pig-iron amounted to 609,431 tons, a decrease of 74,348 tons. The steel output was 570,588 tons, a decrease of 91,351 tons. In the manufacture of pig iron there was used during the fiscal year 1909 a total of 179,735 tons of Canadian ore, a decrease as compared wtih the previous year of 53,778 tons, and of foreign ore 1,037,585, a decrease of 131,221 tons.

From the United States Department of Agriculture and Forestry it is learned that the production of wooden poles for the use of telegraph, railway and telephone poles was less in 1908 than in 1907 in the proportion of 3,249,000 to 3,283,000. But there was a decline in cost of 26 per cent., namely, from $8,081,000, or $2.46 per pole, in 1907, to $5,928,000, or $1.82 per pole, in 1908. The decline in general business is given as the cause of the decline. Sixty-eight per cent. of the poles used are of cedar and 16 per cent. chestnut, the other woods used for the purpose being oak, pine, cypress, juniper and tamarack. The decline in purchases arose from the smaller wants of electric railway and power companies, for telegraph and telephone companies increased their purchases.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The Twentieth Annual Convention of the Canadian Association of Stationary Engineers will be held this year in London, Ont., July 27th to 30th.

**Programme.**

First Day—

10.30 a.m. Opening address of welcome by Mayor Stevely.

2.co p.m. Session.

3.30 p.m. Excursion to Springbank. Launches provided for delegates by the Canadian Fairbanks Company. The remainder of the afternoon and evening the delegates will be entertained at Springbank by the Exhibitors' Association.

Second Day—

9.co a.m. Session.

12.oo a.m. An hour among the exhibits.

1.oc p.m. Delegates and resident engineers will be entertained at the London Hunt Kennels by E. Leonard & Sons. This will be followed by a trolley trip, from which the delegates will return to the hall for the evening session, which will adjourn for the Grand Banquet.

Third Day—

9.oo a.m. Regular session.

2.oo p.m. Installation of officers. Presentation of Past President's Jewel. Closing.

## OBITUARY.

PROFESSOR SIMON NEWCOMB, the astronomer and mathematician, died at his bome, Washington, D.C., July 12th, 1909, at the age of 74. Professor Newcomb was the oldest son of John Newcomb, of Wallace, Nova Scotia. He was educated by his father and taught school in Nova Scotia, and also in the United States, after his removal there in 1853. While in Maryland he became acquainted with Joseph Henry and Julius E. Halgard, who, recognizing his aptitude for mathematics, secured his appointment in 1857 as computor on the Nautical Almanac, then published in Cambridge, Mass. On graduating from the Lawrence Scientific School, in 1858, he continued there for three years as a graduate student. He was appointed professor of mathematics in the United States navy in 1861, being assigned to duty in the United States Naval Observatory, Washington. While there he negotiated the contract for the 26-inch equatorial telescope authorized by Congress, supervised its construction, and planned the tower and dome in which it is mounted. In 1871 he was appointed secretary of the Commission that was created by Congress for the purpose of observing the transit of Venus, December 9th, 1874. He was elected to the American National Academy of Science in 1869, and since 1883 had been vice-president of this organization. In 1876 he was elected president of the American Association for the Advancement of Science, and he delivered his retiring address at the St. Louis meeting, 1878. He had also held the presidency of the American Society for Psychical Research.

# STEAM TURBINES, FROM THE USERS' POINT OF VIEW.*

By Alfred S. Blackman, Borough Electrical Engineer and Manager, Sunderland.

There is such an abundance of literature on the subject of the steam turbine giving descriptions of types and systems, that only a passing reference will be made to this point. Briefly, the present situation of the steam turbine industry is a battle for supremacy between the Impulse and Reaction types, and while the partisans of each type claim all sorts of wonderful advantages which the other does not possess, yet the following statements are put forward as representing the point of view of a user who has studied the problem from all sides. (1) All turbines must fulfil a certain law of combination of blade speed and a number of running rows. (2) Steam expanding between boiler pressure and condenser must generate a certain velocity, and this velocity must be imparted to the revolving mass in small increments as in the Parsons machine, entailing many rows of blades, or in larger increments, as in the Zoelly of Curtis machines, or in one increment as in the Laval. (3) The fewer the rows of running blades the higher must be the speed at which the blades run, and consequently the higher the speed of the steam impinging on the blades. (4) The Impulse type turbine runs at a much higher speed at blading than the Reaction type, and necessitates particular attention being given to the design of the wheels and blades, owing to the greater stresses that prevail. (5) The Impulse type turbine lends itself to a more mechanical-looking construction than the Reaction type. (6) The Reaction type, as illustrated by the best Parsons type, is more economical than the Impulse type. (7) For speeds of 3,000 revolutions per minute and below 1,000 kw. the Impulse type is better than the Reaction. (8) For speeds of 1,500 revolutions per minute and up to 3,000 kw. the Reaction type has, up to the present, proved most satisfactory. (9) For speeds of 1,000 and 750 revolutions per minute, and up to the largest sizes likely to be used, there is absolutely no evidence that the Impulse type can compete in reliability or economy with the Parsons type.

In making the above statements regarding reliability and economy, isolated cases have not been considered, only an opinion expressed on a general survey; and a very important point which must be considered, both for and against the two types, is that the Reaction type has been longest in the field, the uses to which it has been put are of wider application, and the horse-power in use must very greatly exceed that of the Impulse type; whether the Impulse type will come through the many vicissitudes that are supposed to beset all turbines is a matter which has yet to be proved.

A review of the progress of the last two years, the writer thinks, shows that while trouble with the Reaction type has shown a marked diminution—due to the defects of the earlier designs having had time to come to light, thus showing the necessity of more mechanical construction, and notably of stiffer shafts—the Impulse type has not made the headway many people looked for, and may still be said to have its infantile complaints ahead.

### Turbine Outputs and Speeds.

Too little attention is given nowadays to selecting an efficient combination of power and speed, although the latter is such an important point from every point of view. Take two instances:—(1) 750 kw. on 50 cycle; (2) 1,500 kw. on 40 cycle. In case 1 the periodicity being 50, only two speeds can be considered, viz.; 3,000 revolutions per minute with a two-pole machine, or 1,500 revolutions per minute with a four-pole machine. Many engineers have selected the slower speed in putting down their installations, but there is no arguments in reason which can be given against the higher speed of 3,000 revolutions per minute, as the high-speed set will be (1) more economical by about 10 per cent.; (2) take up less floor space; (3) be about 15 per cent. cheaper in first cost.

The same remarks apply to case 2, where of the two speeds of 2,400 revolutions per minute and 1,200 revolutions per minute, it is an uncommercial proceeding to put in the slow-speed set. A very good rule to follow, and one which should be insisted on is:—Choose the size of your unit to suit the highest speed that the periodicity will allow, and here the assistance to be obtained from external fan cooling of the generator should not be overlooked, because the higher the speed at which the set is run, the greater the benefits which will be obtained from a turbine installation.

At Sunderland we have a 1,500 revolutions per minute, Willans Dick Kerr combination installed to carry a load of 2,000 kw. continuously, and 2,500 kw. for two hours, and the economies effected by this plant, have been most pronounced, as is very practically exemplified by the fact that with the present normal works day load, amounting to about 2,300 kw. on the turbine, two boilers will easily steam the turbine, but upon changing over to three modern high speed reciprocating engines, of about 700 kw. capacity each, it is impossible to hold the steam without substantial assistance from a third boiler, and we always hold additional boilers banked against the contingency of a failure of the turbine plant.

For direct-current turbo sets, the merits of the tandem machine must not be lost sight of. For a given size of unit the advantages accruing from tandem machines are many. For instance: (1) by putting in tandem generators, the speed of the set can be increased by about 75 per cent. with all the attendant advantages, as already pointed out. (2) The electrical portion being divided into two, there is only 50 per cent of the machine out of commission should troubles of any sort arise.

### Turbines v. Reciprocating Engines.

It is often a subject of some concern to an engineer to decide at what size of unit it becomes advisable to adopt turbines in preference to reciprocating engines; a general statement which has been made very frequently is that above 750 kw. as a unit use turbines, below 750 kw. use engines. It is, however, impossible to draw any definite line of demarcation, as so much depends upon the available conditions and the requirements. For instance, the temperature and quantity of circulating water affects the situation very seriously, and must be taken into consideration as regards both capital and running costs, before any decision can be arrived at. Every case calls for a detailed investigation, which it will repay to make thoroughly. There is, however, not the slightest doubt that with the higher speeds at which it is now possible to run turbo-generators, the proposition of turbines versus engines, will soon disappear, and it will be a case of turbines only; in fact, it is even now difficult to prove a case for the reciprocating engine under any ordinary conditions.

The Brush Company, who have made a specialty of small turbo-generator sets, give the following typical figures for a 300 kw. plant:—

Steam consumption in lbs. of steam per kw.-hour with steam at 160 lbs. per square inch:—

| | Dry steam. | With 100 degrees superheat |
|---|---|---|
| Reciprocating engine, 26-in. vacuum.. | 24 | 29½ |
| Turbines, 28-in. vacuum ..... | 22 | 19¾ |

The capital cost of the two plants complete with condensers is practically the same.

Granting that capital and steam costs are equal upon so small a unit, and taking into consideration the undeniable advantages the turbine has in cost of oil and general upkeep, it does indeed appear that the reciprocating plant has only a small field left, except upon sites where the facilities for obtaining cooling water are exceptionally bad.

The selection of conditions for turbine installation can be summed up in few words:—

*Paper read before the Incorporated Municipal Electrical Association.

| | |
|---|---|
| (1) 150 lbs. per square inch steam pressure. | Because at pressures above 150 lbs. per square inch the volume becomes small and leakage percentages are increased, with only a small gain in B.T.U.'s available. |
| (2) 150 degrees superheat. ..... | Because there is no appreciable gain in plant over all economy above 150 degrees superheat. |
| (3) Highest possible speed ..... | Already commented on. |
| (4) Best vacuum possible. ..... | Because it is the strongest feature in turbine working, and it will pay to maintain as high a vacuum as possible. |

**Condensing Equipment and Vacuum.**

The condensing plant is the most important detail of the plant, and yet how often is it neglected, or, one should say, not paid sufficient attention to. A vacuum should be selected with an equivalent temperature about 25 degrees above the available temperature of circulating water, and this gives a commercially obtainable and maintainable vacuum. Having once obtained this, see that it is always maintained. If a vacuum of 28½-in. can be obtained, never let it drop to 27½-in., which it will easily do with a little inattention and neglect of glands, joints, sluice, and automatic valves, etc. An inch down in vacuum will mean a 5 per cent. rise in the coal bill. Work this out in expenditure per annum and it will draw its own moral. The writer has found a vacuum recorder kept under lock and key worth considerably more than its weight in gold. The writer is of opinion that the field for improvement in condensing plant is even greater than in turbines.

As regards types of condensing plant in use, this again depends on circumstances. There are three main types:—(1) Surface; (2) low-level jet; (3) barometric.

(1) Surface can be sub-divided as follows:—(a) Ordinary, viz., generally consisting of surface condenser, air pump, and circulating pump. (b) Parson's Augmenter Surface, which is as in (a) with the addition of a steam jet and auxiliary condenser, which allows smaller cooling surface, and less circulating water to be employed. Further, the hot-well temperature is higher than with (a). This is, in the writer's opinion, undoubtedly the best form of surface condensing plant. (c) Counter-current, an arrangement of (a) with compartment drainage. From the point of general works economy, as a rule, the capital cost of surface condensing plant will be rather higher than either jet or barometric condensers.

(2) Jet condensers are made in many highly successful ways, and require, if anything, rather more power than surface plants. Upon account of air entrained with the circulating water, very complete air-extracting apparatus is necessary.

(3) Barometric condensers are a very satisfactory form of plant, provided every precaution is taken to prevent air leakage, and ample passage way given to steam and water. The power taken for pumping is, however, slightly in excess of other types of condensing plant, but from the writer's experience it makes a very satisfactory installation. A great point is the uniformity of the vacuum which can be maintained owing to the absence of cooling surfaces which become dirty and therefore inefficient. In some cases no air pump is installed, but where a high vacuum is essential a really powerful dry air pump is necessary. It is probable that this type of condensing plant has been kept back owing to the fact that when used with reciprocating engines the presence of oil in the exhaust steam put difficulties in the way of using the hot-well water for boiler-feed purposes. With turbines this difficulty has, of course, disappeared, and it is possible that barometric condensing plants will be more heard of in future; they are certainly more easy to maintain at their best than surface condensers.

**Reliability of Turbines as Prime Movers.**

Sunderland experience has shown the Willans-Parsons turbine to be absolutely trustworthy. For over 16 months the bulk of the work has been done by the 2,000-kw. turbine plant of this make, running at 1,500 revolutions per minute, and during the year ending March 31st last, the total units generated in the works were 9,207,227, of which no less than 8,009,000, or 87 per cent. of the whole output, were generated by the one turbine plant.

This turbine has with very few exceptions, been put on load every Sunday at noon, and has run through without any stop until the following Sunday, at about 1 a.m. During the night the load drops, as a rule, to about 400 kw., and the day peaks have been about 2,300 kw.; when this has been exceeded, one or more 700-kw. reciprocating sets have been paralleled. Throughout the day the work has consisted of about three-quarters shipyard and one-quarter tramway load, and it is of a very fluctuating character.

During the whole of this time any sudden mishap to the turbine would have shut the whole system down, because in no case has there been sufficient plant in parallel with the turbine to take the load up temporarily, but in no instance has there been a hitch in any way attributable to the turbine; it runs through week after week with an entire absence of incident. It will be realized that these are severe and exacting conditions, and such dependence upon a single unit calls for the utmost reliability, and after fairly lengthy experience of both high-speed piston valve and slow-speed Corliss valve reciprocating engines, the writer trusts the turbine with equal confidence to either of these alternatives.

**Maintenance of Turbine Plant.**

The writer is of the opinion that maintenance costs on steam turbine plant (consisting of turbine, alternator and condensing plant) complete, should not exceed, say, $500 per annum per 10,000,000 units generated, and if careful record were taken in some of the larger turbine works, and fair maintenance debits were allocated against units generated, it would be found in many cases less than this amount. As a matter of fact, the maintenance of the Sunderland 2,000-kw. plant for the year ending March 31st last, including opening the turbine twice to measure clearances, came to less than $175, and while it is true that the set was under the contractor's maintenance, a detailed and careful check was taken of all that was done to the plant, including the renewal of exciter brushes, etc., and the figure given is a liberal allowance of what it would cost the Corporation to do the same work, although the contractors will have expended more than this, by reason of men's travelling expenses and out-money.

**Exhaust Steam Turbines.**

The advantages of the application of the exhaust-steam turbine do not appear to be fully appreciated, even at the present time. As compared with a high-pressure turbine, an exhaust steam set requires about double the steam, and the gain due to high vacua is more than twice as great. The machine can be of robust construction owing to there being no necessity for fine clearances, and, moreover, the temperature distortions are small. The Impulse type can be of very simple construction for exhaust steam working, but does not, upon the other hand, lend itself so well to economical working as the Reaction type, as it works with higher steam velocities, and if the steam is wet, as is usual, the friction losses due to this cause are high.

Many present-day condensing engine plants, with a good supply of cold water for circulating, could be increased in output by 25 per cent. without any appreciable extra expense, save the capital cost of the exhaust turbine installation; it is, however, the exception to find such plants in electricity works, but their installation seems such an absolutely sound scheme that it is a wonder the development has not been more rapid.

**Economies to be Obtained from Turbines.**

Sunderland experience shows the cost of working with turbine plant to be much lower than with reciprocating engines. The writer has already dealt with maintenance costs, and as regards steam consumption, it has been argued against the steam turbine that it does not maintain its economy, but

the following experience of the writer's shows that good results can be maintained after the hardest work.

The 2,000-kw. Willans-Parsons set installed at Ilylton Road was tested on setting to work, and again on the expiration of one year and two months' work, during which time the plant ran over 9,000 hours, and generated over 9,000,000 units. The steam consumption on a 27½-in. vacuum was 17.07 lbs. of steam per unit on one test, and 17.1 lbs. of steam per unit on the other.

As regards oil, which was logged separately from the other plant, the total cost for the year ending March last was for the turbine, $67, and for the turbine auxiliaries, $92, a total of $159, equivalent to 0.000053 of a penny per unit generated. It would be difficult to claim such a record of maintained economy for any prime mover other than the steam turbine.

## CONCRETE BRIDGE SPECIFICATIONS.*

**By T. H. Macdonald, Iowa Highway Commission.**

It is clearly an impossibility to present anything approaching a complete set of specifications in a paper that would not be tiresome to the auditors and unfair to the other numbers on the programme. I shall, therefore, attempt to touch only a few of what we consider the more important considerations, general and specific, relating to concrete and its use in bridge construction.

The first requirement of any set of specifications should be its ability to defend itself in any court of law, if permissible to express it in this way. That is, a specification should first of all be legal, which would mean the entire absence of catch phrases or the uncommon use of words or phrases that could be construed to the disadvantage of either party. Technical terms and phrases must, of course, constitute a large part of the text, and yet it is possible so to construct them that if read before a jury of twelve men, the meaning and general fairness of the various clauses would be apparent if the finer technical distinctions were not.

This may be well illustrated by the attitude taken by a capable engineer who uses a certain method for determining earth work. This method is not as accurate as some others but he justifies its use because it is easily demonstrated to and understood by a jury as ordinarily made up. It is questionable how long any specification will stand before a jury if the actual facts do not substantiate it.

A second important requirement is the practicability of the methods outlined. It is undoubtedly poor practice to write exceedingly stiff specifications if there is no intention of carrying them out practically as written. There probably never has been a piece of work where little adjustments did not have to be made from time to time as the work progressed, but this does not necessarily mean that the specifications were not practical. And there are also clauses which are included only to be used in the event of certain contingencies. For instance, we specify that no concrete shall be dropped more than three feet while being placed in the forms, but this specification is not strictly enforced unless concrete is being placed in thin sections or in water.

Specifications should also be definite to enable the contractor to know just as nearly as possible the grade of material he will be expected to furnish and the amount of work he will have to do, together with as much other accurate information of this character as possible. For instance, we try to specify the exact elevation to which the contractor will be required to carry his foundations at the price bid, and allow an extra for concrete placed below this elevation.

For large bridges, standard specifications will not prove applicable without the addition of many specific clauses but for smaller structures, particularly for concrete slab culverts, general specifications can be used that prove fairly satisfactory for covering the work of a township or a country. A table has been prepared and is included herewith which shows the thickness, the amount of reinforcing in square inches per foot of width, the stress in the concrete and in the steel for culvert slabs from two to twenty feet clear span. The loading used is the dead load which includes the weight of the concrete and the earth fill plus a concentrated live load of twelve-ton traction engine mounted on axles, eleven-foot centres, the rear axle carrying a weight of eight tons.

The classes of concrete to be used in these structures are as follows:—

For the tops: Class A concrete.

For the side and wing walls: Class B concrete.

For the foundations and footings: Either Class B or class C concrete.

The following is our standard specification for classes of concrete:—

**Classes of Concrete:**—The concrete shall be designated by classes which shall be proportioned as follows:—

Class A. concrete:—1 part cement, 2 parts sand, 4 parts broken stone or screened pebbles passing 2-inch ring.

Class B. concrete:—1 part cement, 2½ parts sand, 5 parts broken stone or screened pebbles passing 2½-inch ring.

Class C. concrete:—1 part cement, 3 parts sand, 6 parts broken stone or screened pebbles passing 2½-inch ring.

**Sand Content:**—Unscreened gravel may be used for classes B. and C. concrete, subject to frequent tests by the engineer to determine the sand and pebble content, and in no case shall the sand be greater than the class requirements or less than is necessary to fill the voids in the pebbles.

Class B. mortar:—1 part cement, 2½ parts sand passing ¼-inch mesh.

The approximate quantities for a cubic yard of concrete of the above proportions are as follows:—

| Kind. | Cement. Barrels. | Sand. Cu. Yd. | Screened Pebbles, Broken Stone. Cu. Yd. |
|---|---|---|---|
| Class A. ..... | 1.57 | 0.44 | 0.88 |
| Class B. ..... | 1.25 | 0.46 | 0.92 |
| Class C. ..... | 1.10 | 0.47 | 0.94 |

**Note:**—"It shall be permissible for the inspector to slightly vary the above proportions of sand and aggregate for the different classes to secure a denser concrete with the materials used."

It will be noticed that we do not adhere strictly to the exact amount of aggregates in the various classes where the materials can be used to produce a smoother concrete by slightly adjusting the amounts as given. The class C concrete is the weakest that we use and at the present price of cement we believe it is false economy to use a leaner mixture, except in very heavy construction, and even then we prefer a fairly rich concrete with one man rubble stone imbedded in this concrete. The division line between sand and gravel is placed at about a No. 8 screen. The advisability of following the specification in regard to determining the sand and pebble content is well illustrated by the following table, which reports the results of tests made on sample sent in from various counties:—

| Gravel. | No. | Pebbles per cent. | Sand per cent. |
|---|---|---|---|
| Greene Co. ..... | 1 | 80.8 | 19.2 |
| Greene Co. ..... | 2 | 46.3 | 53.7 |
| Greene Co. ..... | 3 | 34.3 | 65.7 |
| Greene Co. ..... | 4 | 43.0 | 57.0 |
| Greene Co. ..... | 5 | 57.1 | 42.9 |
| Carroll Co. ..... | 1 | 33.8 | 66.2 |
| Story Co. ..... | 1 | 58.7 | 41.3 |
| Story Co. ..... | 2 | 47.3 | 52.7 |
| Story Co. ..... | 3 | 42.4 | 57.6 |
| Emmet Co. ..... | 1 | 65.2 | 34.8 |
| Emmet Co. ..... | 2 | 30.4 | 69.6 |
| Emmet Co. ..... | 3 | 51.7 | 48.3 |

*Read before the Iowa Cement Users' Association.

## REINFORCED CONCRETE SLABS.

### Live Load—One 12-Ton Engine.

| Clear span. | Effective span. | 1 Ft. | | | 2 Ft. | | | 3 Ft. | | | 4 Ft. | | | 5 Ft. | | | 6 Ft. | | | 7 Ft. | | | 8 Ft. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D | M | C | S | D | M | C | S | D | M | C | S | D | M | C | S | D | M | C | S | D | M | C | S |
| 2 Feet | 2 ft. 6 in. | 6 | 1187 | 510 | 0.40 | 6 | 1465 | 560 | 0.32 | 6 | 1203 | 494 | 0.28 | 6 | 1085 | 413 | 0.24 | 6 | 1022 | 390 | 0.22 | 6 | 1027 | 392 | 0.22 | 6 | 1035 | 390 | 0.22 | 6 | 1068 | 407 | 0.23 |
| 3 " | 3 " 6 " | 7 | 2038 | 497 | 0.35 | 7 | 2192 | 510 | 0.38 | 7 | 1865 | 453 | 0.32 | 7 | 1746 | 424 | 0.30 | 7 | 1728 | 420 | 0.30 | 7 | 1755 | 425 | 0.30 | 7 | 1819 | 442 | 0.31 | 7 | 1899 | 461 | 0.33 |
| 4 " | 4 " 6 " | 8 | 2757 | 467 | 0.40 | 8 | 3010 | 509 | 0.43 | 8 | 2650 | 448 | 0.38 | 8 | 2550 | 432 | 0.38 | 8 | 2586 | 437 | 0.38 | 8 | 2671 | 452 | 0.38 | 8 | 2868 | 474 | 0.40 | 8 | 2908 | 503 | 0.43 |
| 5 " | 5 " 6 " | 9 | 3513 | 485 | 0.48 | 9 | 4355 | 542 | 0.54 | 9 | 4035 | 501 | 0.50 | 9 | 4020 | 500 | 0.50 | 9 | 4170 | 519 | 0.51 | 9 | 4495 | 548 | 0.54 | 9 | 4705 | 585 | 0.58 | 10 | 5083 | 485 | 0.55 |
| 6 " | 6 " 6 " | 10 | 4330 | 589 | 0.58 | 10 | 5490 | 523 | 0.59 | 10 | 5150 | 490 | 0.55 | 10 | 5220 | 498 | 0.56 | 10 | 5486 | 522 | 0.59 | 10 | 5840 | 557 | 0.63 | 10 | 6277 | 598 | 0.68 | 11 | 6818 | 513 | 0.65 |
| 7 " | 7 " 6 " | 11 | 5360 | 552 | 0.62 | 11 | 6700 | 504 | 0.64 | 11 | 6410 | 482 | 0.62 | 11 | 6585 | 496 | 0.63 | 11 | 6985 | 526 | 0.67 | 11 | 7500 | 564 | 0.72 | 12 | 8190 | 499 | 0.71 | 12 | 8830 | 538 | 0.76 |
| 8 " | 8 " 6 " | 12 | 7440 | 559 | 0.71 | 12 | 8710 | 511 | 0.75 | 12 | 8535 | 520 | 0.74 | 12 | 8930 | 545 | 0.77 | 12 | 9585 | 584 | 0.82 | 13 | 10510 | 530 | 0.82 | 13 | 11320 | 572 | 0.82 | 13 | 11320 | 572 | 0.89 |
| 9 " | 9 " 6 " | 12 | 8700 | 535 | 0.75 | 13 | 10200 | 517 | 0.80 | 13 | 10300 | 520 | 0.81 | 13 | 10750 | 543 | 0.84 | 13 | 11600 | 585 | 0.91 | 14 | 12800 | 541 | 0.92 | 14 | 13925 | 589 | 1.00 | 15 | 15215 | 550 | 1.01 |
| 10 " | 10 " 6 " | 13 | 10100 | 510 | 0.70 | 13 | 11760 | 593 | 0.92 | 14 | 12040 | 510 | 0.87 | 14 | 12815 | 542 | 0.92 | 14 | 13870 | 586 | 0.99 | 15 | 15300 | 552 | 1.01 | 16 | 16900 | 527 | 1.04 | 16 | 18320 | 570 | 1.12 |
| 11 " | 11 " 6 " | 14 | 11350 | 573 | 0.89 | 14 | 13560 | 574 | 0.97 | 14 | 13800 | 583 | 0.99 | 15 | 15010 | 532 | 0.99 | 15 | 16340 | 590 | 1.08 | 16 | 18100 | 563 | 1.11 | 17 | 19970 | 540 | 1.14 | 17 | 21975 | 595 | 1.26 |
| 12 " | 12 " 6 " | 14 | 13020 | 550 | 0.93 | 15 | 15570 | 564 | 1.03 | 15 | 16010 | 578 | 1.06 | 16 | 17550 | 546 | 1.08 | 16 | 19130 | 595 | 1.17 | 17 | 21200 | 573 | 1.21 | 18 | 23445 | 559 | 1.26 | 19 | 25975 | 543 | 1.30 |
| 13 " | 13 " 6 " | 15 | 14800 | 515 | 0.98 | 16 | 17750 | 552 | 1.09 | 16 | 18425 | 573 | 1.13 | 17 | 20240 | 548 | 1.16 | 17 | 22110 | 597 | 1.27 | 18 | 24600 | 586 | 1.32 | 19 | 26950 | 569 | 1.36 | 20 | 29830 | 591 | 1.42 |
| 14 " | 14 " 6 " | 15 | 16670 | 591 | 1.08 | 17 | 20120 | 544 | 1.15 | 17 | 21040 | 570 | 1.21 | 18 | 23180 | 552 | 1.24 | 19 | 25750 | 544 | 1.30 | 19 | 28200 | 597 | 1.43 | 20 | 31190 | 588 | 1.49 | 21 | 34280 | 579 | 1.55 |
| 15 " | 15 " 6 " | 16 | 18450 | 574 | 1.13 | 18 | 22700 | 541 | 1.22 | 18 | 23850 | 568 | 1.28 | 19 | 26360 | 557 | 1.33 | 20 | 29380 | 553 | 1.40 | 21 | 32600 | 550 | 1.47 | 21 | 35020 | 599 | 1.61 | 22 | 39140 | 598 | 1.68 |
| 16 " | 16 " 6 " | 17 | 20300 | 560 | 1.19 | 18 | 25050 | 597 | 1.35 | 19 | 26960 | 570 | 1.36 | 20 | 29900 | 562 | 1.43 | 21 | 33320 | 562 | 1.51 | 22 | 37040 | 564 | 1.59 | 23 | 40840 | 566 | 1.67 | 24 | 44890 | 597 | 1.75 |
| 17 " | 17 " 6 " | 18 | 21850 | 551 | 1.24 | 19 | 27950 | 591 | 1.41 | 20 | 30230 | 569 | 1.44 | 21 | 33680 | 568 | 1.52 | 22 | 37566 | 572 | 1.61 | 23 | 41700 | 576 | 1.70 | 24 | 46020 | 580 | 1.80 | 25 | 50440 | 582 | 1.88 |
| 18 " | 18 " 6 " | 18 | 23180 | 599 | 1.35 | 20 | 31150 | 586 | 1.40 | 21 | 33780 | 570 | 1.53 | 22 | 37620 | 571 | 1.61 | 23 | 41990 | 581 | 1.72 | 24 | 46660 | 587 | 1.82 | 25 | 51490 | 595 | 1.92 | 26 | 56500 | 597 | 2.02 |
| 19 " | 19 " 6 " | 19 | 27950 | 591 | 1.41 | 21 | 34550 | 583 | 1.56 | 22 | 37650 | 574 | 1.61 | 23 | 42060 | 581 | 1.72 | 24 | 46920 | 592 | 1.83 | 26 | 52700 | 557 | 1.89 | 27 | 58060 | 567 | 1.99 | 28 | 63650 | 575 | 2.09 |
| 20 " | 20 " 6 " | 20 | 30450 | 583 | 1.48 | 22 | 38150 | 581 | 1.64 | 23 | 41710 | 577 | 1.71 | 24 | 46640 | 589 | 1.82 | 26 | 52700 | 558 | 1.89 | 27 | 58500 | 571 | 2.01 | 28 | 64440 | 582 | 2.12 | 29 | 70510 | 590 | 2.24 |

D—Depth of beam in inches. M—Max. Mom. in ft. lbs. C—Compressive stress in concrete in lbs. per sq. in. S—Area of steel in sq. in. per ft. of width.

A variation in the compressive strength of these samples mixed in a proportion one part cement to six of the sample is illustrated by the seven and twenty-eight day tests given:—

**Compressive Strength of Gravel Concrete.**

| Gravel. | No. | 7 Days, lbs. sq. in. | 28 Days, lbs. sq. in. |
|---|---|---|---|
| Greene Co. | 1 | 625 | 1,030 |
| Greene Co. | 2 | 774 | 1,490 |
| Greene Co. | 3 | 636 | 1,170 |
| Greene Co. | 4 | 475 | 865 |
| Greene Co. | 5 | 557 | 1,195 |
| Carroll Co. | 1 | 504 | 1,137 |
| Story Co. | 1 | 720 | 1,485 |
| Story Co. | 2 | 735 | 1,370 |
| Story Co. | 3 | 531 | 1,275 |
| Emmet Co. | 1 | 940 | 1,950 |
| Emmett Co. | 2 | 389 | 744 |
| Emmett Co. | 3 | 465 | 873 |
| Average | | 612.6 | 1,215.3 |

The specification for classes of concrete is referred to in the following paragraph:—

**"Measuring and Proportioning:**—The proportions of the different classes of concrete shall be carefully maintained by some method of measuring satisfactory to the engineer, the cement being measured as packed by the manufacturers and the aggregate loose. The use of bottomless boxes and square wheelbarrows of uniform size, designed for this purpose, will be accepted as satisfactory methods."

Without going into this subject too much in detail, it is perhaps worth while to include the following specification for the reinforcing steel:—

**"Reinforcing Steel:**—Except as otherwise specifically stated herein, all reinforcing steel used shall be of such a section as to provide a mechanical bond at frequent intervals and to insure a thorough contact between the steel and concrete. Net sections, sizes and distribution and bonding shall be exactly as shown on the drawings. The transverse bars shall consist of one-half inch round rods placed in pairs as shown on the drawings, and connected by a lattice bar of the required length, punched with five-eighths inch holes, and placed at intervals of three feet. The lattice bars shall be held rigidly to position by blocking to the forms and wiring to the bars it crosses. Medium steel, having an elastic limit not less than 32,000 pounds per square inch shall be used, and shall withstand cold bending equal to twice the diameter of the test piece without fracture. Only steel free from rust, dirt and grease shall be used, and some means shall be provided for cleaning the surface of the steel before placing."

## PATENTS.

The following is a list of Canadian patents recently obtained through the agency of Messrs. Ridout & Maybee, 103 Bay Street, Toronto, from whom further particulars may be obtained:—

Antoine H. Imbert, electric rotary furnace; Lyman Melvin Jones, combined side delivery rake and hay tedder; Lyman Melvin Jones and R. H. Verity, lifting device for mower cutter bars; John Taylor and E. W. Buckley, mechanical weft feeling mechanism for looms; John Taylor and E. W. Buckley, mechanical weft feeling mechanism for looms (No. 2); John Taylor and E. W. Buckley, mechanical warp stop motion for looms; Wm. Henderson, stoves; Thomas L. Mullally, portable sectional coverings; Milton E. Shantz, Grate Bars; J. C. Wagg, stone gathering machine; Ernest W. Lee, baker's peel.

## FIREPROOF CONSTRUCTION IN REINFORCED CONCRETE.

There appears to be a general lack of knowledge of the recent rapid development of the important features which enter into fireproof construction whereby its cost has been materially reduced. It now costs only about 10 per cent. more to build a structure in which the fire hazard is practically negligible than one of the slow-burning type. Although the cost of thoroughly fireproof construction as provided by reinforced concrete is naturally somewhat greater than that of ordinary construction, its durability and its exemption from fire risk greatly reduce the net annual charges.

The advantages of reinforced concrete as a fireproof material are well set forth in a paper recently presented before the National Fire Protection Association by Mr. Leonard C. Wason, president of the Aberthaw Construction Co., of Boston, from which we quote in part:—

"Numerous fire tests have been made to determine both the resistance of concrete to actual test, and also the depth to which the reinforcement must be embedded to prevent its being damaged. The maximum depth of pitting observed by the writer in actual fire tests where a temperature of 1,700 degrees F. or more has been maintained for a period of five hours has been in either walls or ceilings, one inch to one and one-half inches. Also, by the examination of actual conflagrations, such as that at Baltimore and elsewhere, it has been apparent that the pre-arranged fire tests are more severe in the results shown by the structure than actual conflagrations. Therefore, if we can protect the materials against damage in a pre-arranged test, they will stand any actual service. The concensus of opinion of engineers is that there should be at least one inch of concrete between the nearest point of a bar to the ceiling in panels, at least two inches below the steel in beams and girders, and also two inches of concrete outside the vertical bars in columns. In designing columns it is common to figure only that area of column inside the vertical bars when hooped as carrying the load, or, if hoops are omitted and but light reinforcement is used to prevent bending stresses, to add an extra inch beyond that needed to carry the load all around the outside, which might be burned away without endangering the load-carrying capacity of the balance of the column within. If this is burned off it can be plastered back, giving the column the same fire-resisting qualities as before.

"The other types of fireproof construction which are coming into competition with reinforced concrete are structural steel encased in concrete, and this, when thoroughly encased from a fireproof standpoint, is similar to an all-concrete building. Structural steel frame encased in terra cotta, and to a small extent plaster of paris and brick have been used in fireproofing steel, but not to a sufficient extent to be worthy of much comment. Thoroughly well-laid brick work is a good protection to columns, but when cast as arches between beams it leaves the bottom flange exposed, which is a serious defect. Actual conflagrations have conclusively shown that terra cotta is not so perfect a fire protection as concrete. This is largely, in the writer's opinion, due to the fact that its coefficient of expansion is high, so that it expands to such an extent that when confined between the beams it is crushed, the lower member falling, and thus weakening the floor. It is also more susceptible to a combination of fire and water, being to some extent brittle, and cracking when a cold stream strikes a hot surface.

"Before concrete will disintegrate when exposed to fire the large amount of moisture chemically combined in the setting of the cement being 20 to 25 per cent. of its weight, has to be driven off by heat, and then the vapor thus driven off has to be evaporated from the pores of the concrete before it becomes sufficiently hot to crumble. The slowness of evaporating this vapor is probably the cause of concrete resisting extremely high temperatures for the brief period of a few hours, while a much lower temperature, if long continued, would ultimately disintegrate it. Cement will resist 500 degrees F. for an indefinite period, while a continuous temperature of over 790 degrees F. is disastrous. The cement coating of the stones of the concrete will resist the attack of fire so long that it is of less consequence whether the stone can be damaged by the fire or not. Thus, pure limestone is a most excellent aggregate, and will not decompose until after the cement has, and after the cement has gone it it immaterial what aggregate is used, as the work has then failed anyway.

"Regarding the cost of this type of construction as compared with others, the large use has proved conclusively that it will compete, because the item of cost is considered paramount in ninety-nine out of every hundred structures. For large buildings the structural frame is almost always cheaper than the steel. Thin curtain walls cannot be built as cheaply on account of form work, which is constant for a thin wall as well as for a thick one, but if the wall must be sixteen inches or more in thickness concrete is cheaper than brick."

## THE TRUE VALUE OF CONSERVATIVE REINFORCED CONCRETE CONSTRUCTION.

M. C. Tuttle.*

The advisability, if not the necessity, of allowing a sufficiently large factor of safety in the design of reinforced concrete buildings to provide against serious injury from the action of fire, should be emphasized. In considering the value of concrete as a fireproof building material, it is well to remember what are its constituent parts. Well made stone concrete consists of crushed stone or gravel, sand, and Portland cement, in such proportion that each particle of sand is coated with cement, and that each piece of stone is covered with mortar. In the best concrete the stones are graded, and when the whole is mixed and tamped the result is a compact mass with mortar between. Fire has a varying effect on different kinds of stone, but when this stone is covered with mortar as in well made concrete its destructive effect is decidedly less.

A block of concrete subjected to a severe heat for a short time would crumble somewhat, and upon cooling would show considerable strength. If heated red hot a similar block would become soft and probably be broken by a severe blow. The stones on the outside may have disintegrated, but those on the inside would be found intact and covered with mortar.

Experience has shown that the action of fire on reinforced concrete is of a similar nature. The concrete on the under side of reinforced concrete floors may crumble to a more or less extent, and if there is not enough to spare the steel will be overheated and serious injury done. In the case of columns surface disintegration may so decrease their bearing area that collapse of both columns and floors is a possibility. Of such buildings, where the factor of "fire safety" is small or non-existent, the most that can be said, is, that they are non-combustible.

Hence in a conservative design ample concrete should be specified to protect the steel and the concrete immediately about the steel. In event of a fire the damaged concrete surface may then be inexpensively repaired with plaster, and the floors and columns still retain their figured strength. Under similar circumstances, the repairs on a light structure would be found very expensive, while the cost of removal of the whole building would be so great that owners and designers would not care to consider it.

It is obvious, then, that it is decided economy in the end to employ honest, capable designers and contractors, and to pay a fair price for the work done. In no other way can satisfactory results be obtained.

*Of the Aberthaw Construction Company, Boston, Mass.

## PANAMA CANAL EXPENDITURES.

The classified expenditure on the Panama Canal up to May 1st, 1909, is as follows:—

| | |
|---|---|
| Civil administration | $ 2,806,491 |
| Sanitation | 8,468,515 |
| Construction and engineering | 45,195,326 |
| Municipal improvements | 6,428,439 |
| Plant account | 38,759,489 |
| Total | $101,658,260 |

This is actual construction expenditures and does not include the price paid for the French franchise or to Columbia—$50,000,000 in all.

## PERSONAL.

MR. FRANK BARBER, County Engineer for York, and for a number of years chief assistant engineer to Mr. J. McDougall, late County Engineer of York, and Mr. C. R. Young, B.A.Sc., Lecturer in Applied Mechanics of Toronto University, and for three years connected with the structural departments of the Dominion Bridge Company, and Canada Foundry have entered into partnership as consulting and designing engineers on steel and concrete bridges and general engineering. Their offices will be 57 Adelaide Street East, Toronto, Ont.

MR. CHAS. F. BOEHLER, B.S.A., a graduate of Cornell University, has been given charge of the Landscape Department of Stone and Wellington, nurserymen, Toronto, Ont.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of July 7 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price July 9 '08 | Price July 1 '09 | Price July 8 '09 | Sales Week End'd July. 8 | Price July 9 '08 | Price July 1 '09 | Price July 8 '09 | Sales Week End'd July. 8 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,611,000 | 1,399,000 | 162 | 183 | 183 | 20 | 163 | 162½ | 182½ 182 | 183⅜ 182¾ 1078 |
| Canadian Northern Railway | 2,986.9 | | | 179,200 | 152,300 | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 768,409 | 728,831 | | *1st. pref. 105½, 3rd pref. 56½, ordinary 23¾ | | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | 29,072 | 16,337 | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 75,474 | 70,389 | | | | | 172¾ | 172½ | 218¼ 218 | 218 217 200 |
| Toronto Street Railway | 114 | 8,000 | 100 | 74,711 | 68,488 | | 123¾ | 124½ | 41 | 99 | 98½ | 124 123¾ | 124 123¾ 665 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 156½ | 187½ 186 | 186 185¾ | 35 | 156 | | | 185¾ 40 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## JUNE RAILROAD EARNINGS.

| Company. | Month of June, '09. | Month of June, '08. | Increase. | Jan. 1 to June 30, '09. | Jan. 1 to June 30, '08. | Increase. |
|---|---|---|---|---|---|---|
| C. P. R. | $6,354,000 | $5,458,000 | $896,000 | $34,968,860 | $30,034,000 | $4,934,860 |
| C. N. R. | 805,000 | 682,400 | 122,600 | 4,043,800 | 3,712,500 | 331,300 |
| G T. R. | 3,506,056 | 3,422,858 | 83,198 | 18,239,944 | 17,735,596 | 504,348 |
| T. & N. O. | 114,194 | 68,116 | 46,078 | 645,029 | 358,294 | 286,735 |
| Montreal Street | 319,446 | 299,737 | 19,709 | 1,720,792 | 1,630,747 | 90,045 |
| Toronto Street | 308,335 | 281,912 | 26,423 | 1,756,479 | 1,624,560 | 131,919 |
| London Street | 20,936 | 20,233 | 703 | 108,965 | 105,098 | 3,867 |

## TORONTO RAILWAY COMPANY.

The earnings of the Toronto Railway Company for last week were greater by $1,755 than those of the Montreal Street Railway. This is the first time this has occurred.

## QUEBEC STREET RAILWAY.

The Montreal directors of the Quebec Street, Light and Power Company recently returned from an official inspection of that system.

Mr. J. N. Greenshields, K.C., a director of the company, in discussing the matter, said that he was convinced from what he saw that the Quebec Street Railway will prove to be a little later on one of the most profitable traction corporations in the country.

"We inspected the city lines and offices, and we went over the line to Ste. Anne de Beaupre. Of course, nothing definite has been decided as yet, but I may say that the whole system will be greatly improved, such as new extensions, double tracks, larger cars, and faster time, and also by arranging for less change of cars from lower to upper town. A trip to the exhibition grounds was made across the St. Charles River. We found this line in fair condition, but by building a new bridge across the river the cars will be enabled to serve a larger area, and thereby afford access to a new section of the district which is rapidly filling up with the working classes. An inspection was also made of the St. Foy and St. Louis lines. The idea, I should think, would be to run a loop line out by St. Foy and back by St. Louis. It is also intended to double the elevator capacity at Montmorency Falls to the Kent House as the increase of traffic demands it."

## LEVEL CROSSINGS.

The Canadian Railway Commission has directed all railway companies to furnish by September 1st a return showing all crossings at which accidents have occurred since January 1st, 1900. In the case of every crossing where more than one has occurred there must be statements of the protection existing. The statement, which is to be full and explicit, must be certified to by a responsible officer of the company.

The receipts and expenses of the Cape Breton Electric Co. (including its share in the Sydney and Glace Bay Railway Co.) for the first four months of 1909 as compared with 1908, are as follows:—

| | 1909. | 1908. |
|---|---|---|
| **Receipts.** | | |
| January | $18.331 76 | $20,864 68 |
| February | 15,891 54 | 18,024 43 |
| March | 16,462 33 | 17,432 06 |
| April | 16,511 14 | 18,073 65 |
| **Expenses.** | | |
| January | $12,090 87 | $12,692 73 |
| February | 11,559 27 | 11,827 44 |
| March | 11,142 49 | 11,433 07 |
| April | 11,208 85 | 10,790 17 |

Toronto Railway net May earnings increased $30,784, and five months' net increased $131,315.

For six months the Montreal Street Railway shows gross earnings of $1,823,421 against $1,734,069 for the same period last year

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## THE ONTARIO GOVERNMENT vs. THE CAMERON SEPTIC TANK PATENTS.

When a deputation from a number of Ontario municipalities waited upon the Premier of Ontario asking his assistance in the septic tank difficulty they found an interested and sympathetic listener.

Since then it has been announced that the Government will secure expert advice on the question of alleged infringement of patents.

No matter what this report may say, it is safe to predict that the report will not end the matter. The question will yet be fought out in the Canadian courts. It will be well that the matter receive early attention, for many municipalities are interested and several schemes are being delayed by the uncertainty.

## PROFITABLE SEWAGE DISPOSAL.

**W. A. Mackinnon.***

The meetings of the seventh International Congress of Applied Chemistry recently held in South Kensington have been full of interest, but perhaps no subject with which they have dealt concerns the general public more closely than sewage disposal. A paper read before the Hygienic Section describes a system which unites the elimination of undesirable products from sewage intended for use as fertilizer, with the utilization of these very products for the purpose of making commercial profit.

**Ordinary Method of Sewage Disposal.**

At present the contents of sewers are in some towns discharged into large tanks where solids are settled out forming a "sludge" containing about 90 per cent. of water. This is filtered, reducing it to a cake which contains only about 50 per cent. of water, which is usually dumped on land specially secured for the purpose. As the writer of the paper points out, however, a city of 100,000 will produce something like 30 tons of sludge per diem; the cost both for land and cartage becomes tremendous, and the land used for dumping is unfitted for building purposes.

**Sewage as Manure.**

When the sludge is used as manure it necessarily creates a nuisance to the neighborhood, in the course of decomposition; to this objection is added another, namely, that while the chemical composition of the sludge would indicate considerable fertilizer value, this is greatly diminished, and in some cases quite extinguished by the presence of large quantities of fatty matter, grease and soap. These come chiefly from domestic sources, the washing of dinner dishes providing much grease, while practically all the soap used in the country (the estimate for England is 4,000,000 tons annually) ultimately finds its way into the sewers.

**Acids the Source of Profit.**

It is from the recovery of the valuable fatty acids contained in the soap that the process now recommended derives a large part of its revenue, the remainder coming from the residue of the sludge cake, the fertilizing value of which can now be realized, while the resulting manure is also sterilized and odorless, so that it can be stored or used without creating any nuisance. It takes the form of a dry powder, fine as flour, containing nitrogen equal to 8 per cent. of sulphate of ammonia, and other chemicals, together with about 40 per cent. of partly decomposed organic matter.

**Description of the Process.**

The system is as follows:—The sludge cake having been dried by heat is mixed with a little acid and passed through a specially designed retort in which it is subjected to a current of superheated steam, which carries away with it the fatty acids to be condensed in a water-cooled tower. The fat can be easily and cheaply purified, yielding a grease rich in steria acid—a valuable commercial chemical. The average profit for a city of 100,000 is estimated at, roughly, $12,500.

*Trade Commissioner for Canada at Birmingham, in his report to Ottawa.

## THE PURIFICATION OF WATER BY OZONE.

**M. L. Borne,—Société des Ingenieurs Civils de France.**

The problem of pure water supply has been solved at Chartres, France, a city of about 23,000 inhabitants, by the addition to the existing works of apparatus for treatment of the water by ozone. The waters of the River Eure, from which the supply for Chartres is drawn, contain numerous bacteria, many of them of a pathogenic character. These are entirely removed by the ozone treatment. The apparatus installed, which has a capacity of about 6,000 cubic metres (1,600,000 gallons) per day, represents an outlay of only $70,000. The low first cost of this plant and its complete success are evidence of the economy and efficiency of the process. We take a few details of the practice at Chartres from a recent paper by M. L. Borne, read before the Société des Ingenieurs Civils de France.

Power is supplied by two 40 horse-power steam engines, one of which is held in reserve. Each engine drives an alternator. The water is raised to the filter plant by means of a centrifugal pump. The apparatus for the production of the ozone is wholly enclosed in glass. It consists of two hollow metallic electrodes, separated by glass and cooled by jets of water, which receive the current, at 500 periods and 15,000 volts, from the generator. The ozone is produced by the sparkling between the electrodes. Cooled and dried air is supplied to the case containing the ozone apparatus by means of a fan. The ozonated air is led to a Gay-Lussac tower which receives at the top the water to be sterilized. The tower has two compartments, each 1½ by 7 meters, filled with crushed flint to a depth of 4½ metres.

The sterilization of 1 cubic metre, (265 gallons) of water requires 370 litres of air containing 5/6 milligram of ozone per litre. A little more than 2 grams of ozone are required, therefore, for each cubic metre of Eure water treated. The amount of ozone required varies, of course, with the amount of organic matter in the water. That of the Chartres supply contains about 3 milligrams of organic matter per litre.

The clarifying plant comprises ten sand filtres, 6 by 7 metres, with a sand bed 1 metre thick supported on iron grills which allow the escape of the water and facilitate mechanical cleaning of the filtres. The capacity of these filters is about 15 to 20 cubic metres per square metre of filter surface per day. Before reaching the sand filters, the water passes

through biological filters filled with coke, two of which precede each sand filter and are operated alternately. In them the water is subjected to an oxidizing action, and about 80 per cent. of the bacteria are removed.

The filter plant with piping and appliances for cleaning cost 90,000 france and the building containing the filtres, 60,000 francs. The first cost was therefore 25 francs per cubic metre of water treated per day. The ozone installation cost 110,000 francs, inclusive of the sterilizing tower. Adding to these amounts the cost of the land, the electric plant and the piping connecting the two plants, the total cost of the water treatment works was 350,000 francs for a capacity of 6,000 cubic metres per day, a first cost of 58 francs per cubic metre. Excluding the cost of the land this is reduced to 50 francs per cubic metre.

Purification plants embodying in their design all modern improvements are higher in first cost than those of the old types, but the cost of ozone treatment increases only very slightly the unit cost of operation. Allowing 5% interest on capital and a plant life of forty years, the purification of water containing not more than 1 milligram of organic matter per litre varies between 0.025 and 0.013 francs per cubic metre when ozone sterilization is used, according to whether clarification of the water is necessary. The cost of filtration without sterilization varies between 0.010 and 0.015 francs per cubic metre.

## MODERN ASPECTS OF SEWAGE DISPOSAL AND SEWERAGE PROBLEMS.*

**T. Aird Murray.†**

Sewage and water purification have, during the last 50 years, passed through an evolutionary period. These two subjects are closely related. Sewage contamination to a large extent provides the most objectionable impurities usually found in water. There are certain diseases which are recognized as capable of being water borne; such as typhoid, dysentery, cholera, etc. On the other hand, there may be impurities connected with water which are organic, and may have nothing to do with sewage contamination. Two distinct public duties are now being recognized in order to guard health from the evils of impure water; one, prevention in the first instance, or the guarding of water supply sources from pollution; and the other is taking proper measures to remove and counteract any pollution either organic or inorganic in the water before serving it out to the public.

The problem of prevention comprises the subject of efficient sewage disposal. Wherever one or more persons locate, sewage is a necessary product. When people live in communities and are served by a common water supply conveyed by pipes, the product "sewage" is about equal to the amount of water supply. A water supply is the cleansing medium of a town; it is used not only for dietetic purposes, but also to scour and wash away human waste or dirt. It is not sufficient that water be supplied by pipes and led to taps, it must, in the converted form of sewage, be further taken care of and led away as quickly and cleanly as possible, and either disposed of where it may be harmless or be rendered harmless before being disposed of. Domestic sewage, as well as containing effete poisonous organic matters, is charged with innumerable microscopic organisms to the number of from 20 to 40 million per thimbleful or cubic centimeter. Many of these organisms are known to be harmful, and are the effective carriers of the infection of disease.

There is a constant fight between the human body and disease; victory to the host means the passing off of disease. In zymotic cases, disease is passed off in the form of media which is infectious. The free and constant use of water is the chief means of carrying away the infectious media. We must take precaution that the media is not transmitted to others by the water or brought back into contact with ourselves.

We rely upon the water which drops as rain for our water supply. The water may be used direct as surface water from rivers or creeks, or brought back from the earth into which it has percolated by dug wells or by natural springs. The water may be mixed with water which has already been in human use. Unless the well or spring is sufficiently isolated from human contact, or unless the river or creek flows from an uninhabited area, such a mixture is generally inevitable.

It is generally recognized that water is sent by Providence as a necessity to the welfare of mankind. It is now generally being recognized that it is a crime on the part of mankind to unnecessarily pollute this God-sent water. If it is necessary for a community to use this water, and it is so necessary, then it is the duty of the community to return the water which it has borrowed, as pure as it is possible to reasonably make it, so that others may also have the privilege of the right of using that water without fear of evil from it.

Hence, the question of sewage disposal. It has already been said that the principals and application of methods of sewage disposal have undergone a period of evolution. The subject has received a great amount of attention both in Europe and in the United States. It is now receiving attention in Canada. Canada has not too early opened its eyes to the fact that it cannot neglect this subject. Canada in one respect is in a fortunate position, inasmuch as it can profit by the experience of other countries and the great amount of experimental and research work done.

Last year there was published to the world the results of nine years' experiments and collection of valuable evidence in the shape of the 5th Report of the Royal Commission on Sewage Disposal (Great Britain). Immediately after the report came the results of about nine years' experiments by one of the greatest authorities on the subject, Professor Dunbar, of the Hamburg Institute of Hygiene. The conclusions and results of these two authorities practically coincide, and it is not difficult for the sanitary engineer trained to deal with this subject, to crystalize the whole matter, and provide water to any degree of efficiency required to suit the local conditions under particular consideration.

Many old pre-conceived theories with reference to sewage disposal have received their death blow. Chief among these is the well-known and well-advertised septic tank.

At one time, advocates of the septic tank held that it solved the sludge question, inasmuch as all the organic solids were digested by putrefaction. The Royal Commission by extensive experiments at the parent septic tank installation at Exeter, have shown that not more than 25 per cent. of the sludge is thus got rid of, while other authorities put the putrefaction elimination as low as 6 per cent.

It was also held that zymotic germs were killed by septic action. Nothing of the kind happens. The effluent from a septic tank is bacteriologically as impure as the sewage entering it. It was further held that the putrefactive process which breaks up the organic carbons, prepared the sewage so that it was more easily oxidized by land or other filter processes. Nothing of the kind. Dunbar has clearly shown that you can successfully treat three times as much fresh settled sewage, as you can septic liquor on the same area of filter bed.

But there still remain some who maintain the total digestion theory, because, after the sludge attains a certain height in the tank, it may stop at that height. The reason for this cessation of accumulation has been thoroughly demonstrated. If the sludge is allowed to remain, it becomes broken up into finer particles, when it attains a certain height, it is stirred up by the inflowing sewage and mixes with the liquid, and an amount of solids in fine particles equal to the amount of solids of solids entering the tanks passes off at the outlet. Hence, there is no further accumulation of sludge in the tanks. After three months' working the increase of solids passing out of a septic tank is 50 per cent.; at six months

*Read before the Saskatchewan Medical Association at Saskatoon, July 7th, 1909.

†Sanitary consulting engineer, Toronto, and advising engineer to the Government of the Province of Saskatchewan.

about 70 per cent. The result is, that, if such tanks are used as preliminary settling tanks for the removal of solids to prevent filters or land from choking, they are attended with failure as compared with the ordinary sedimentation tanks in which septic action is not allowed to prevail.

The above does not mean that septic tanks stand absolutely condemned. There are occasions in which it is both expedient and profitable to use the septic tank, such as for instance, where no purification is looked for and where only the grosser and unsightly solids are required to be removed and no further purification by filtration is necessary. In such cases the benefit by any sludge digestion and saving in maintenance by neglect of sludge removal may be taken advantage of.

Let it be understood, however, that a septic tank or any number of septic tanks do in no way chemically change the sewage and render it harmless. It is not a means of purification, but only a means of partial retention of the objectionable solids, a small per centage of which will disappear by the ordinary process of putrefaction if left undisturbed.

The organic constituents of sewage are changed into their now putrescible inorganic forms by a process of nitrification, by which organic nitrogen is oxidized to nitrates and nitrites. This is the natural process which takes place in soils, by which organic effete matter is rendered into forms suitable for the rebuilding of plant life.

The process of nitrification is connected with the presence of oxygen and micro-organisms and may take place either in ordinary soil or in specially designed biological filter beds.

By allowing sewage to run over land of an open and friable nature, the sewage gradually percolates into the land, the organic matter is absorbed by the soil in the upper layers and is then gradually oxidized or nitrified. Where an equilibrium can be maintained between the amount of organic matter retained and the active power of the nitrifying organisms, the purifying efficiency of soil is perpetual. We have an example of this perpetual action in soil where the autumn decay of vegetable growth is re-absorbed year after year to provide food for future growth.

The organic matter in sewage, however, forms a very small proportion as compared with the volume of water, hence the great difficulty of maintaining land, dosed continually with sewage, in a condition in which nitrification can be efficiently effected. The large volume of water renders nitrification slow and ineffective, hence equilibrium is not maintained. The organic matter obtains the mastery, the land chokes and becomes what is called sewage sick.

Various methods have been tried to ease the land of part of the burden of sewage purification. The solids have been strained from the sewage or precipitated both by the use of chemicals or otherwise, but still it has been found, unless under exceptional conditions of sand land, land has failed to deal with the large amount of liquid forming the chief component of sewage.

"Broad Irrigation" and "Intermittent Filtration" are the two recognized methods of land treatment.

Broad irrigation simply means using the sewage for irrigation purposes on crop lands and distributing it by means of ridges and furrows. Intermittent filtration means the employment of land devoted solely to sewage disposal apart from any crop consideration, the land being divided into lots, which alternately receive a dose of sewage, thus giving time for the liquid to pass out of the soil pores, the admission of oxygen, higher nitrification, and a possible maintenance of equilibrium as between retention and oxidation.

Dr. Hodgets, assisted by Dr. Amyot, of the Ontario Provincial Board of Health, was instrumental, after many careful experiments with the sewage of Berlin (Ont.), in introducing land intermittent filtration for that city. The sewage is screened and the solids partly settled out by simple precipitation, the liquid sewage being taken care of by a large tract of ideal sand land divided into lots. The effluent sewage continues to show a high degree of purity during both summer and winter, and the oxidation equilibrium is so far maintained.

When land is resorted to as the purification media, the system of intermittent filtration provides the greatest measure of success. The continued success depends, however, entirely on the suitability of the land. It is seldom possible to obtain suitable land just in the locality required; hence, the system has been tried on land of a clayey character, and in all such cases the system has had to be abandoned.

The unsuitability of land led sanitarians to experiment with, and to adopt in practice, chemical treatment methods. Almost all the chemicals which can possibly act as re-agents on the organic compounds of sewage, have been tried. None have been really successful. Chemical sewage purification is a thing of the past, althought there are occasions in which the use of a coagulant may be useful in settling out solids which otherwise are difficult to precipitate, such as in the case of brewery wastes, etc. Such, however, only occupy a position in preliminary treatment and not in the final treatment of purification.

All the labor and thought which has been expended on land treatment has not been wasted. The Lawrence (Mass.) experiments were commenced in order to determine the best character and amount of land suitable for sewage disposal. It was early demonstrated that the purification process of sewage was not the simple result of filtering or straining the sewage by passing it through soil pores. Simple gravel, the size of peas or walnuts, was found to be more effective than ordinary soil, when worked under certain conditions. Sewage purification was found to depend not only on the mechanical action of retention, but on an action of deorganization depending on the presence of oxygen accompanied by micro-organisms, which in the presence of oxygen have the power of splitting up complex organic compounds into their more elementary inorganic forms. Hence the biological system of sewage purification. This system makes sewage purification independent of the character of the land; all that is required is a solid base on which to build simple structures, ideal homes built for the propagation and maintenance of the nitrifying and other organisms, homes or filter beds, if you like to so call them, in which under proper conditions and management the equilibrium between retention, absorption, and oxidation can be successfully maintained.

Biological sewage disposal does not mean revolution, but devolution. It is not the utilization of any new invented process. It is the perfected utilization of nature's own process, the process by which all effete organic matter has been reduced on the cycle of birth and death since the commencement of this planet as an organic constitution.

Any degree of purification required can be obtained. It is, however, a question of reasonable purification and of cost. The system is capable of measurement in length, breadth, and depth. Given an analysis and estimated amount of sewage, a plant can be built accordingly. These nitrifying homes will act in any climate, provided they are guarded from zero chills. The area occupied is small, they are easily and cheaply protected.

The success of the system depends upon the following essential features: (a) Preliminary treatment for removal of as much of the solids from the sewage as possible. This is best done by simple sedimentation tanks of a capacity from 12 to 24 hours daily flow. In such tanks the velocity flow is reduced to such an extent that from 60 to 70 per cent. of the solids precipitate by gravity, while the matters of a specific gravity less than water float to the surface. Scum boards are fixed at the inlets and outlets to keep back the floating matter from the outlet. The solids should be removed once every two months at least, either by gravity when there is sufficient fall, or by means of a hand chain pump. The solids are allowed to flow in to dug out, well drained drying beds, shallow in depth to allow of evaporation, and the sludge can be dug into land when sufficiently dry.

(b) Secondary treatment of passing the sewage through filtering media about walnut size. The depth of the media

should not be less than 3 feet, and it is unnecessary to have it more than 8 feet. Within these limits success does not so much depend upon the depth of the media, as upon the cubic quantity of filtering material bearing a certain relation to the amount of sewage to be treated. With ordinary domestic sewage there should not be less than one cubic yard of filtering media to each 150 gallons of dry weather flow of sewage to be treated. Success depends further upon even distribution of the sewage over the whole surface of the filter. There are various appliances for this purpose. The best up to date is the revolving sprinkler worked automatically by the sewage In cold climates, owing to frost this apparatus must be cut off in winter and alternative distribution provided by means of weeping pipes fixed 6 inches below the filter surface. The sewage must be fed intermittently over the surface by means of an automatic dosing tank at a rate of not more than two gallons per each square yard of filter surface, so as to allow of each dose to draw air with it and guard against any hydrostatic head forming in the filter, causing undue hurry in percolation or flushing by means of which the nitrifying organisms may be removed from the filter.

Such a biological system will so chemically change any ordinary sewage that it is no longer sewage. The effluent will be non-putrescible, incapable of further fermentation or producing any nuisance.

But what about the removal of intestinal bacteria and pathogenic germs? Is it pretended that this simple process of sedimentation and passing sewage through matured material of walnut size, and subjecting it to nitrification, is capable of retaining or exterminating the micro-organism of disease? Any man who makes this claim for either the above process or for any of the other known ordinary processes of sewage disposal, stands condemned as ignorant of the results of modern sanitary research work.

The biological method, or the land intermittent filtration process, will greatly reduce the number of B. Coli, and other bacteria, but will not efficiently reduce their number to bring the effluent anywhere near the bacterial standard required for drinking water. Fortunately the greater number of bacteria are not isolated as individuals, but are either in colonies held together by gelatinous matter, or are wrapt up and held by suspended solids. The result is that the retention of the solids in the settling tanks will retain from 60 to 70 per cent. of the bacteria entering with the sewage. A further reduction is effected by the retention of organic solids in suspension and organic solids in solution absorbed in the filter to the amount of about 85 per cent. of the number entering the filter. So large, however, is the original bacterial count, that the resultant percentage is still in a proportion to render the non-putrescible effluent unsafe for dietetic purposes, unless mixed with a large volume of pure water. The life of the resultant bacteria in an effluent practically free from organic matter and thoroughly oxidized, is very short.

It, therefore, cannot be denied that although it is absurd to speak of nitrified sewage as potable water, a great and beneficial work is accomplished.

This nitrified and non-putrescible sewage effluent can be rendered practically sterile if required. The process, however, is in most cases unnecessary. Slow sand filtration as applied to drinking water, is effective to the extent of about a 95 per cent. further bacterial removal. Sterilization can be effected by chlorine processes at a cost of from 80 cents to one dollar per 1,000,000 gallons of sewage treated. The question in all such cases to be considered is the character of the stream into which the effluent enters and mixes. In many cases it will be found that the stream or river receiving the sewage effluent, is organically more impure than the purified sewage, or in other cases, that the volume of the stream or river is so great in proportion to the sewage effluent that an analysis of a sample taken one hundred yards below the effluent will compare equally with one taken above the effluent

In the case of rivers or streams passing through settled areas, pollution does not depend solely upon the sewage of combined communities. There are a hundred and one other causes which may constitute polluting sources. In the case of a community drawing water from any such source, it would appear, apart from the question of whether sewage is treated or not, that a duty still remains to provide that such water is rendered beyond suspicion. In Europe, in Great Britain, and in the United States this question of the relative responsibility as between the degree of purification required for sewage effluents on the one hand, and the obtaining of a pure water supply on the other, has received a great amount of attention. The concensus of opinion is that the responsibility must be divided. It is considered unreasonable to ask a community to discharge a sterilized sewage effluent, on the other hand, it is considered reasonable that those responsible for the supply of water should take all necessary measures to deliver that water in a pure condition. Sewage purification to the extent of producing a non-putrescible effluent, goes a long way towards making the work of supplying a pure water an easy one. In fact, if measures to this extent are not adopted, the supply of a pure water becomes almost a practical impossibility.

The production of a non-putrescible sewage effluent means, an effluent which will not change the visible character of a stream, it will not affect fish life, and when 1,000 times diluted, may be safely used for watering cattle one hundred yards below the effluent outlet; and when 10,000 times diluted with equally pure water, may be used for dietetic purposes half a mile below the effluent outlet with comparatively no risk.

The main point, however, as far as drinking water is concerned is this, that whenever water is drawn from any suspicious sources, such as surface water from settled areas, such water should be treated by either mechanical or slow sand filtration, or rendered sterile by any of the well-known methods of ozone or hypochlorite.

The foregoing general description of a biological plant applies more particularly to what is termed the percolating filter process as distinct from the "contact bed system." This paper would be incomplete without a reference to the "contact" system.

The percolating system is the most modern development of biological treatment; the "contact bed" was the earlier method of application. With the former the sewage is allowed to percolate continuously through the filtering material from the surface to the base—with the latter the shell holding the filtering media is made water-tight so that the filter remains full of sewage for a period of time. The rule generally in vogue is, say an hour to fill with sewage, an hour for the tank to remain full of sewage, and an hour for the tank to remain empty for a period of rest or recuperation.

The principal of the contact bed has no scientific basis; it is purely empirical. It was a question of how best to bring the sewage into contact with every particle of filtering material so that the nitrifying organisms might have full scope for their energies. The obvious solution was, fill the tank to the point of saturation and give every organism an equal chance. In order to give these organisms a good and a long chance, a period of contact was assumed as necessary. After what was supposed to be a sufficient period of contact, the outlet valve from the bed was opened, the treated sewage drawn off, analyzed and disclosed an abundant presence of nitrates and nitrites, proving that the desired chemical change had occurred. It was at once assumed almost without debate, that the nitrifying organisms fed, as it were, upon the organic matter in the sewage and rested their jaded appetites during the period when the bed remained empty. Dibden, and others in England preached this from the very house tops, and contact beds were scattered over the land, as the end-all and final conclusion of the sewage problem. The humor of the whole farce lay, however, in attaching to these contact beds preliminary treatment in the form of septic tank action. It was claimed that the septic half of this treatment represented anaerobic fermentation, fermentation apart from light and air. It was further claimed that the second half the contact bed treatment represented aerobic fermentation, or fermentation in the presence of free oxygen.

Doubters, however, appeared on the scene—the scientist and the bacteriologist were not satisfied. Professor Dunbar of Hamburg made a visit to England, saw, examined and spoke. He said, but both your tanks are anaerobic, your contact beds stand full of sewage, oxygen is excluded during the very period when you claim nitrification, which depends on oxgyen, takes place. There is something wrong. Dibden and others would not argue, they pointed to Sutton in Surrey, and other plants and simply said, look at the results; there is an argument you can't get over. Dunbar went back to Hamburg and started experiments on an extensive scale in his own slow methodical German manner. The result of those experiments is the most valuable ever produced in connection with sewage disposal. Nearly all that was mystery is made clear. Nitrification does take place in the contact bed, but not during the period of contact. During this thought to be valuable period, practically nothing happens; the bacteria, as it were, waited in patience, waited till the liquid sewage was withdrawn and the entrance of oxygen and their feeding time commenced on the organic compounds left clinging to the filtering media from the departed liquid. The nitrates and nitrites were the result not of the last sewage dose, but of previous doses. Dunbar showed that better resnlts could be obtained by a three-minute period of contact and a three hours rest. In fact, that the period of contact was humbug, without a single scientific point in its favor. Hence, the percolating or continuons filter and the period of contact abolished and remaining of historical interest only.

The difficulty of equal distribution has, as above explained, been overcome, the result is, no time is wasted, nitrification continuously goes on, free oxygen is ever present, and the equilibrium between retention and oxidation maintained granted that the proportions between the sewage treated and area of filter bed is correct.

The whole process of the decomposition of sewage cannot yet be said to be cleared up. Sufficient, however, has been demonstrated to prove that it is not merely the simple bacterial action as at first understood. The attacking and digesting of organic compounds by ravenous bacteria was a simple and easy explanation appealing to anyone who had ever seen the wild animals fed in a menagerie. It takes a certain length of time before a biological filter arrives at maturity; it was thought at one time that this maturity depended upon the necessary supply of nitrifying organisms being developed. Nothing of the kind! Maturity depends upon the ability of the filter to extract, absorb, and retain the organic matter both in suspension and in solution from the sewage. The power of absorption and retention depends not on the presence of micro-organisms, but on the gradnal formation of a gelatinous film of a spongy character which covers the superficies of the filtering material. The film under the microscope presents a coral like appearance and has an immense power of suction and absorption. An inch in area presents about one million square inches of suction surface. The organic compounds in the sewage are absorbed by this sponge film, which is charged with micro-organisms. The presence of oxygen is necessary for its growth. In this sponge film the organic compounds are broken up and oxidized, but how much of this action is due to the mere chemical action of oxidation, and how much is due to the influence of the bacteria directly, is as yet unknown. Probably a combination of both chemical and biological action is necessary, as the sterilization of a filter by a strong antisceptic causes nitrification to cease for a time.

An interesting and practical feature in connection with contact versus percolating beds is that three times the amount of sewage can be even more efficiently treated on a given area of filtering media by the adoption of the percolating system in preference to the contact. The British Royal Commission make this point clear.

Before closing this paper it will be well to say a few words on the question of main sewerage. On the system of sewerage adopted, to a large extent depends the success of any system of sewage disposal. The main sewerage should wherever possible be on the "separate" system; that is, it is advisable that only domestic sewage, together with roof water and cellar drainage, be collected for treatment. Storm water from the surface of streets and roads must be separately dealt with, and may be allowed to discharge direct into the river or stream, as at such times the streams or rivers will be in flood and can easily take care of this large volume of only slightly polluted water. The separate system is necessary to successful sewage treatment, as it allows of a fairly exact estimate being made of the amount of sewage requiring treatment. If surface water be admitted into the sewage sewers, it means either works built to an extent enormously greater than is ordinarily required, or else with works suitable for the sewage only; it means a hopeless mess and complete unsetting of the biological system in times of heavy rainfall.

From a hygienic point of view the combined system of sewerage presents grave objections. In order to take the large volume of surface water during heavy rain storms and prevent backing and flooding of cellars, large diameter sewers must be built. The velocity of flow necessary for the removal of solids are only maintained in such sewers when running half-full or over; consequently, in dry weather, when only domestic sewage is flowing, the velocities are reduced to such an extent that they form simply long lengths of cesspools in which the solids are retained in hot, dry weather, giving off the noxious smells so common at the manholes on such systems.

The separate systems call for only small diameter pipes in which high velocities are maintained, which ensure constant, complete removal of solids, and consequently little or no sewer gases.

The cost of the separate system is generally considered against its adoption; it appears so much more simple and economical to make the one line of pipes serve all purposes. This saving is more apparent than real. In dealing with surface water it is not necessary to run sewers up all short lengths of streets. If the roadway is properly graded and there is a fall to either end, the road channel may be allowed for the drainage. When, however, it is a question of sewage disposal, any saving in cost in adopting the combined in preference to the separate system in the first instance, immediately vanishes, and if it is a case of pumping the sewage at the disposal work, then the saving in the case of the separate system at once makes itself evident.

Some are content, however, to provide what are called storm overflows, so that in time of heavy rain, when the river is in flood, the excess volume of water may be allowed to proceed direct into the stream without treatment. These storm overflows would be all right as such if they discharged only storm or surface water; but the opposite is the case. With the combined system, especially with flat or almost level grades, the large sewers, as we have seen, become stored with putrefying filth; practically, in dry weather, only the liquid dribbles through and finds its way to the treatment plant. As dry weather continues, this storage of filth goes on increasing until the long-looked-for storm comes along, fills the sewers, the storm overflows come into action, and the whole of the collected putrefying mass of filth which the works were built to purify is swept clean into the stream by way of these so-called storm overflows. Sewerage systems constructed on the above lines are the cause of the common saying: "We never had smells or illness until we had drains."

In order to show how compact the biological system of sewage disposal is and how little area it takes up, the following figures are given, comparing the amount of land necessary for various populations, capable of treating three times the dry weather flow, for broad irrigation, intermittent land filtration, and biological treatment on the percolating continuous system:—

Broad irrigation requires about one acre per 1,000 gallons of sewage per day.

Intermittent land filtration requires about one acre per 5,000 to 20,000 gallons of sewage per day, depending on the porosity of the land.

Biological treatment requires one acre per 1,452,000 gallons of sewage per day at the rate of 150 gallons per cubic yard of filtering material at six feet deep, independent of the porosity or character of the land on which the filters are constructed.

Comparing the above, and assuming each 1,000 gallons of sewage as a unit:—

Broad irrigation—One acre will treat one unit.

Intermittent land filtration—One acre will treat twenty units

Biological treatment—One acre will treat 1,452 units.

Assuming a water supply of 60 gallons per head per day, towns of the following populations would require the following areas of land in the cases of broad irrigation and land intermittent filtration and the following areas of filtering material requiring protection from severe frost in winter in the case of biological treatment. To the figures in each case, from one to three acres of land would be required for settlement tanks, sludge removal, and general elbow room. Dry weather flows are given, but the areas are capable of treating three times this quantity.

| Pop. | Gals. of sewage per day. | Broad irrigation. Acres. | Intermittent filtration. Acres. | Biological, 3 feet deep. Acres. | Filtration, 6 feet deep. Acres. |
|---|---|---|---|---|---|
| 1,000 | 60,000 | 60 | 12 to 3 | .08 | .04 |
| 3,000 | 180,000 | 180 | 36 to 9 | .24 | .12 |
| 6,000 | 360,000 | 360 | 72 to 18 | .48 | .24 |
| 9,000 | 540,000 | 540 | 108 to 27 | .72 | .36 |
| 12,000 | 720,000 | 720 | 144 to 36 | .88 | .44 |
| 13,000 | 780,000 | 780 | 156 to 39 | 1.04 | .52 |
| 24,000 | 1,440,000 | 1,440 | 288 to 76 | 1.76 | .88 |

From the above it will be seen that the total area requiring protection from severe frost for a population of 24,000 people is just under one acre. Why, they listen to the chronic pessimists, who say sewage purification is impossible in Saskatchewan because of the severity of the winter! Only a short time ago there were many to be found who said it was impossible to produce wheat in this Province. Many who held such opinions are still among the living. Let them gaze from their feet to the horizon and conclude that this Province has no room for the pessimist.

In conclusion, Dr Seymour has asked me to say a few words as to my prospective duties in connection with the post of engineering adviser to the Government of Saskatchewan on health questions. I may state that I am against adopting any universal standard of degree of purity required with reference to sewage effluents. Every problem must be considered in the light of local conditions. What may be necessary in one locality may not be necessary in another. The quality of a sewage effluent depends upon the character and volume of the stream into which it enters. I do not wish by my advice to the Government to harass unnecessarily any community, or create hardships for the sake of carrying out something which may be good in principal, but may have no particular practical application to the case in point.

My endeavor will be, along with Dr. Seymour's co-operation, and, I trust, with the co-operation of all the medical men in the Province, to guide the new and youthful communities in these matters with a view to the future, so that any work done may not be wasted and errors committed which may in the future be regretted. The principle of my action will be based on the belief that this Province of Saskatchewan is in the near future to become largely inhabited, and that villages are evolving every day, villages will become towns, towns will become cities. Let us, then, make the right start to the very best of our knowledge in matters appertaining to the general health.

The progress, morality and happiness of a community depends upon its measure of health. Health is a jewel beyond price. I shall make errors; "It is human to err." Kindly point out, frankly and immediately, such errors. It may be unfortunate to err. It is a thousand times more unfortunate to do so and not know of the error. By mistakes in life we discover the fittest. Errors are the educational force in the whole process of evolution.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7392—June 29—Granting leave to the North American Telephone Co. to erect, place, and maintain its wires across the track of the Brockville and Westport Railway at Soperton, Ont.

7393—June 21—Dismissing application of the Red Mountain Railway Co. for amendment to Order No. 2115 (making applicable the general interswitching Order), prescribing the rates to be charged for interswitching between the tracks of the Red Mountain Railway and those of the Columbia Western Railway at Rossland, B.C., amending previous Order of the Board dated February 14th, 1906.

7394—June 28—Ordering and directing that the G.T.R take and expropriate certain lands additional to those they now occupy lying between Wyndham Street on the west, Market Street on the north, and the right-of-way of the G.T.R.

7395—July 2—Authorizing the Hamilton, Grimsby & Beamsville Electric Railway Company to construct, maintain, and operate spur through the lands owned by Algernon McKay, of the Township of Saltfleet, County of Wentworth, Ont., connecting the H. G. & B. Electric Railway with those of the G.T.R.

7396—July 3—Granting leave to the M.C.R.R. to construct an interchange track with the track of the G.T.R. on Bathurst Street, London, Ont.

7397—July 3—Granting leave to the G.T.P. Railway to construct its railway across three highways at grade between Sections 22 and 27, Township 51, R. 20, West 4th Mer., between 27 and 28, and between Sections 32, Township 51, R. 20, and Section 5, Township 52, R. 20, west 4th Mer., Alberta.

7398—July 3—Granting leave to the C.P.R. to construct a new crossing over the tracks of the main line of its railway in the town of Coleridge, Alta.

7399—July 5—Authorizing the C.P.R. to reconstruct bridge No. 105.6 over the Victoria Road, Pembroke, Ont.

7400 to 7411, inclusive—June 30—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the track of the C.N.R. at eleven different points, and over the C.P.R. at one point in the Province of Alberta.

7412 to 7423, inclusive—July 2—Granting leave to the B.T. Company to erect, place, and maintain its wires across the track of the C.P.R. at five points in Ontario, and one in Quebec; across the G.T.R. and five points in Ontario; and across the Pere Marquette R.R. at one point in Ontario.

7424—June 30—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.N.R. about one mile west of Mundare, Alta.

7425—July 5—Granting leave to the Caradoc & Ekfrid Telephone Company to cross with its wires the track of the G.T.R. on the town line between Caradoc & Ekfrid Townships, Ont.

7426—July 5—Granting leave to the Perth & Christies Lake Telephone Association to cross with its wires the track of the C.P.R. at the Third Line of Bathurst, County of Lanark.

7427 and 7428—July 5—Granting leave to the rural municipality of Miniota, Man., to erect, place, and maintain its wires across the track of the G.T.P. Railway at P.C. 3½ miles east of Quadra, Man., and at P.C. two miles northwest of Quadra, Man.

7429—June 30—Granting leave to J. P. Ernst, of New Hamburg, Ont., to erect, place, and maintain wires across

the track of the G.T.R. at side road between Lots 13 and 13, Township of Willmot, Ont., about 1 mile east of Baden station.

7430 and 7431—July 5—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. at ¾ of a mile west of railway company's station at Taber, Alta., and at Deveber Avenue, Taber, Alta.

7432—July 5—Granting leave to Morris & Kemp to erect, place, and maintain telephone wires across the track of the C.P.R. at P. Rd. 1.8 miles north of Chaudiere Junction, Township of Gloucester, Ont.

7433—July 3—Authorizing Paul Sylvester, of St. Cuthbert, P.Q., to lay water main under the track of the C.P.R. one mile east of station.

7434—July 5—Granting leave to the Canadian Pacific Railway to construct its railway across highway, at mileage 13.52, Township of Glenelg, County of Grey, Ont.

7435—July 5—Approving and sanctioning proposed deviation of the Manitoulin and North Shore Railway, between stations 739 and 1140, portion of its railway between Sudbury and Little Current.

7436—July 5—Approving location and detail plans of the Central Ontario Railway Company's proposed new station and freight shed at Bloomfield, Ont.

7437—July 6—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the track of the C.P.R. about 2½ miles west of Rosenroll, Alta.

7438—July 6—Authorizing the T. H. & B. Railway to reconstruct, or alter railway bridge known as 45.83 over which it crosses a side road or highway leading to the Ancaster & Copetown Road, Township Ancaster, County Wentworth, Ontario.

7439—July 6—Authorizing the corporation of the city of Quebec, to lay and thereafter maintain water and drainage pipes under the track of the C.P.R. in St. Malo Ward, St. Valier, P.Q.

7440—July 6—Granting leave to the G.T.R. and C.P.R. to appeal from the Order of the Board, dated the 9th of June, 1909, to the Supreme Court of Canada, upon all questions of law involved, in re application of the city of Toronto, Ont., for Order directing G.T.R. and C.P.R. to carry York Street and certain other streets under the tracks of the said companies.

7441—June 30—Reporting to the Governor-in-Council for sanction by-law of the V.V. & E. Railway and Navigation Company re spitting in cars and on premises.

7442—July 7—Granting leave to the B.T. Company to cross the tracks of the G.T.R. with its wires at Duke and Durham Streets, Lindsay, Ont.

7443—July 6—Granting leave to the British Columbia Telephone Company to cross the tracks of the E. & N. Railway at east end of Railway Bridge, at Victoria, B.C.

7444—July 7—Granting leave to John M. Bergstrom, of Wauchope, Sask., to cross the track of the C.P.R. with telephones wires at Wauchope, Sask.

7445 to 7454, inclusive—July 7—Granting leave to the Government of the Province of Alberta, to cross with its telephone wires the track of the C.P.R. at certain points in the said province.

7455 to 7458, inclusive—July 7—Authorizing the corporation of the city of Saskatoon, Sask., to lay water and drain pipes under the track of the C.N.R. and C.P.R. (C.N.R. 3) (C.P.R. 1) at four points in the said city.

7459—July 7—Authorizing the corporation of the town of Chesley, Ont., to lay water main under the G.T.R. at four streets in the said town.

7460—July 8—Approving by-law of the Atlantic and Lake Superior Railway authorizing Chas. R. Scoles, general manager, to prepare and issue tariffs of tolls to be charged for all traffic carried.

7461—July 8—Granting permission to the Hull Electric Railway Company to operate its cars over the tracks of the C.P.R. in the city of Hull, P.Q.

7462—July 7—Authorizing the C.P.R. to construct bridge No. 15 83 over the Bremner River, on the Schreiber Section, Lake Superior division of its line.

7463—July 6—Approving plans of G.T.R. new combination passenger and freight station at South Indian, Ontario.

7464—July 6—Approving detail plans of the G.T.R. new combination passenger and freight station at Corinth, Ont.

7465—July 8—Granting leave to the municipal corporation of the city of Lachine, P.Q., to cross, by means of a subway, for pedestrians only, the tracks and lands of the G.T.R. between 15th and 16th Streets, city of Lachine, P.Q.

7466—July 8—Granting leave to J. P. Coutlee, engineer-in-charge of the Georgian Bay Ship Canal, to construct a highway crossing over the track of the C.P.R. at Temiskaming Villiage, County of Pontiac, P.Q.

7467—July 6—Authorizing the municipal corporation of the Township of Sandwich East, to construct a suitable public crossing across the tracks of the P.M.R.R. at Edna Street in the said township.

7468—July 8—Authorizing the C.P.R. to construct, maintain, and operate spur to and into the premises of the Waterloo Manufacturing Company, Portage la Prairie, Manitoba.

7469—July 6—Granting leave to the Malahide & Bayham Telephone Company to cross with its wires the track of the M.C.R.R. at public road about one mile east of station, in the town of Tillsonburg, Ont.

## SUBSTITUTION OF CONCRETE FOR BRICK WORK IN BOSTON SEWERAGE WORKS.

In view of the fact that the laying of brick costs the city of Boston about four times as much as it should, and that the total cost of brick masonry is over twice as high as the cost of concrete, the consulting engineers, Messrs. Metcalf & Eddy, of Boston, recommend that concrete be substituted for brick work wherever possible without detriment to the sewerage works. They point out in a recent report that there are two questions affecting this particular branch of the work:—

First, is the selection of brick as a building material in all cases justified?

Second, is the brick masonry, where adopted, economically built?

With regard to the first question, there may in some cases be a reasonable difference of opinion, as there are a number of arguments in favor of the use of brick instead of concrete, the only other material available for the larger sewers. One of these arguments is that it is practicable to make brick work more nearly water-tight than concrete. This argument, of course, loses its force to a large extent when the construction is in a locality which is not materially subject to the influence of ground water, and also when applied to surface water drains. Moreover, concrete as a building material is used in a great many structures which should be as nearly water-tight as possible, and has given satisfactory results in cases of very many sewers.

An argument which has been advanced in favor of brick linings for inverts is that the brick are said to withstand the erosive action of the flow of sewage or surface water better than concrete does. Under certain conditions where velocities of flow are very high, there is no doubt that this argument has considerable force. It does not, however, justify the use of brick in the arch, and sewers laid with concrete inverts are very common. Under some circumstances, possibly brickwork may be constructed as cheaply as concrete, but in general it will cost from 33⅓ per cent. to 100 per cent. more. The engineers, therefore, believe that on the whole there is no justifiable reason for using brick work to the extent that it is now used by the Sewer Division of the City of Boston They consider it possible to thus make a saving of about 50 per cent. on the entire cost of masonry wherever concrete can be substituted.

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### AMOUNT OF COAL CONSUMED IN PUMPING, GALLONS OF WATER PUMPED, AVERAGE HEIGHT PUMPED, COST PER MILLION GALLONS, IN ERIE, PA.*

| Year. | Tons coal consumed | Cost coal from Jan. 1, to Dec. 31. | Grades of bituminous coal. | Gallons of water pumped. | Increase or decrease. | Number of places supplied. | No. of fire hydrants. | Average height of water in Reservoir above surface of Bay. | Cost coal per million gals. pumped. | Gallons pumped per pound of coal. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1880 ..... | 3,076.1 | 6,978.41 | Lump, | 775,805,250 | 31,995,150 d | 3,568 | 126 | 232.0 | 8.99 | 126.0 |
| 1890 ..... | 2,583.6 | 3,052.89 | Slack, | 1,659,625,551 | 184,267,331 i | 7,728 | 372 | 236.9 | 1.81 | 322.4 |
| 1900 ..... | 5,285.9 | 7,754.34 | Slack, | 3,124,440,644 | 402,118,040 i | 12,451 | 595 | 235.46 | 2.482 | 295.57 |
| 1907 ..... | 5,664.12 | 9,928.88 | Nut & Slack | 4,326,096,848 | 204,806,994 i | 16,520 | 820 | 236.08 | 2.295 | 381.85 |
| 1908 ..... | 6,382.3 | 10,009.88 | Nut & Slack | 4,483,392,032 | 157,295,184 i | 16,761 | 840 | 235.78 | 2.366 | 351.24 |

High service system installed in 1899, comprises all the territory south of Nineteenth Street. In this district the average lift in feet for 1908 was 298.05. See Pumping Statistics. Steam is also used for auxiliary purposes, such as steam siphons, elevating coal, running machine shop, heating buildings, stand pipe, etc.

*From the forty-second annual report of the Commissioners' of Waterworks.

## COST OF CLEANING LAND.*

Frequently it is found necessary to clear land not only of the standing timber, but of logs and stumps as well. Town sites, reservoir sites, the location of dams and roadways have often to be cleared up.

### Hand Method of Clearing Logged-off Land.

Until recent years clearing was almost wholly done by what is now known as the "by-hand" method, where the laborer, equipped with peavey, mattock, shovel, and ax, undertook to clear up. By this method the standing trees and brush were slashed; a fire was started and allowed to burn over the entire slashing, when most of the brush and small logs were burned completely. The remaining logs were sawed into convenient lengths, piled, and burned. The smaller stumps and roots were grubbed and pulled out. Often a stump puller of the capstan type was used in pulling the smaller stumps after they had been loosened by digging around them.

This type of stump puller is often used in clearing small tracts after the stumps have been broken into several pieces and loosened by the use of stumping powder, without which no clearing is undertaken in the present day. The stump puller should be of simple construction, strongly built. It generally consists of a drum, a wire cable, and a sweep to which a team is hitched. Powder has been used in all clearing operations for several years, and all methods, except that of burning the stumps, are dependent upon it to loosen the stumps so that they may be taken out.

### Donkey-Engine Method of Clearing Logged-off Land.

Some six or seven years ago when logs were drawn in the market, and many logging outfits were idle, an enterprising logger took a contract for pulling the stumps from a meadow. He conceived the idea of using his donkey engine with its outfit of blocks and cables to pull and pile the stumps for burning. The usual method is to slash and burn over the tract to be cleared, in order to burn all the underbrush and as many small logs as possible.

*Adapted from circular No. 25, United States Department of Agriculture.

Then all the stumps more than 1 foot in diameter are split and loosened by a charge of stumping powder of from five to twenty sticks, according to size. A charge of twenty 1½-inch by 8-inch sticks will generally split a 5-foot stump into five pieces and loosen it so that an engine can pull the pieces from the ground.

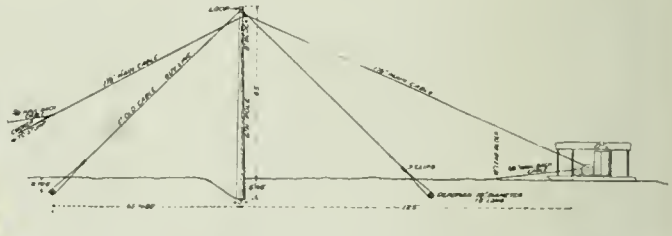


**Fig. 1.—Elevation showing method of setting donkey engine and gin pole in clearing land.**

A gin pole is now set in the centre of a tract of 8 or 10 acres and held in place by four guy lines from the top. (See Fig. 1.) This pole should be 60 feet or more above the ground.. A block is fixed securely near the top of the gin pole, through which is passed the main cable from the engine. This cable has the usual hook, ring, and swivels at the end, and is usually 1 inch or 1⅛ inches in diameter.

The haul-back cable, which is usually ⅝-inch in diameter, is now taken to a lead block and passed around three sides of one-fourth of the tract to be cleared at this setting of the gin pole, (see Fig. 2), and the end hooked into the ring of the main cable, thus forming an endless cable with the engine—one that will run in either direction to or from the gin pole.

In some cases, where the engine is built with the haul-back cable drum above the main-cable drum, it is better to fasten the block for the main cable about 5 feet from the top of the pole and run the haul-back cable through a block on top of the pole. The haul-back drum is usually geared to run much faster than the main-cable drum.

Each outfit should have on hand at least four chokers and a supply of lead lines and extra blocks. A choker is a section of cable from 20 to 30 feet in length, with a loop in one end and a choker hook on the other.

The choker is passed around the stump and hooked upon itself. The loop is then caught in the hook of the main cable, and the load is ready to go to the pile.

While this load is going to the pile another is made ready, so that there is no time lost. When the cable returns with the empty choker it is loosened and another hooked into its place. As the loads come to the gin pole they are piled around it as closely as possible (Fig. 3) by a man on the pile.

This method, while an economic success in the hands of a few, has proved a costly method of clearing as handled by many others. If everything is handled to advantage by capable, experienced men this method has many points to its credit over any other method of clearing now in use, the greatest of which is the saving of time. It is also cheaper than the "by-hand" methods on large tracts of heavy clearing.

The question of using a large or small donkey engine has been discussed, but those who have been most successful in clearing are generally in favor of an engine with sufficient power to take all roots out with a straight pull, avoiding the

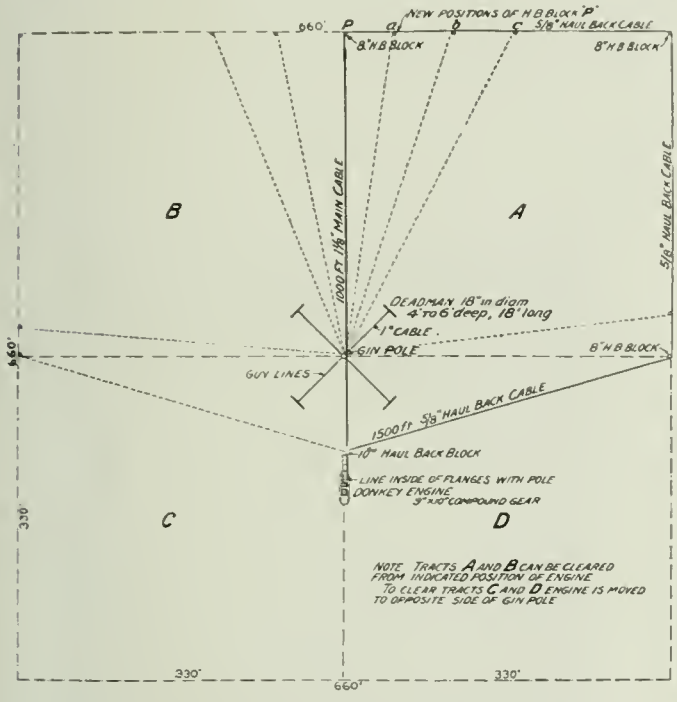



**Fig. 2.—Diagram showing position of donkey engine and rigging for clearing a 10-acre tract.**

use of blocks. A 9 by 10 inch compound gear, or 10 by 12 inch single gear, is said to be the best size for this work.

### Use of Powder in Clearing Logged-off Land.

At the present time few undertake to clear even a small tract of land without the use of powder, and in the hands of an experienced man powder can be made to do a large amount of work at comparatively small expense.

The powder in general use at the present time is known as stumping powder, and is put up in sticks of 1½ by 8 inches, about 65 of which come in a box of 50 pounds. This powder costs at the present retail price $6.25 a box: in ton lots, $5.25 a box.

The charge of powder is placed as nearly as possible beneath the centre of the stump. The powder should be placed on the hardpan if the soil is not too deep; otherwise it is placed from 2 to 3 feet below the surface.

To get the best results the sticks are removed from the paper wrappers and packed closely together in the hole beneath the stump. This can not be done in wet places. The powder works best when the temperature is about 70 degrees F.

This powder has more effect when the soil is saturated with water. The wrappers are allowed to remain upon the sticks in wet places.

The following charges will be found effective under average ground conditions and where using stump pullers or blocks and teams:—

| Diameter of stumps in inches | 18 | 24 | 30 | 36 | 48 | 60 | 72 |
|---|---|---|---|---|---|---|---|
| Sticks of powder | 5 | 7 | 10 | 20 | 35 | 50 | 65 |

Where the soil is sandy and loose it will require one-half more powder for the same size stump.

As this powder does not work well at a temperature below 70 degrees F., it is necessary when using it in cold weather to keep it warm by some method. Some powder men bury the boxes in a manure pile; others lay it upon a perforated rack over boiling water. As in either of these methods the powder becomes more or less damp from the vapor it is thought that when dry heat is applied better results are obtained.

The following statement of stumping done by the Narrows Land Company, of Tacoma, Wash., for six months in 1907 will give an idea of the cost of the different items of material used and the labor in blasting stumps.

**Fig. 3.—Stumps piled around gin pole in clearing with donkey engine.**

**Table I.—Cost of removing stumps from 1 foot to 4 feet in diameter from 120 acres of land in 1907.**

| Month. | Powder. Lbs. | Fuse. Ft. | Caps. No. | Stumps. No. | Labor. Hours. | Labor. $ |
|---|---|---|---|---|---|---|
| June | 13,700 | 10,100 | 2,400 | 2,135 | 2,380 | 650.00 |
| July | 1,750 | 2,050 | 400 | 239 | 260 | 87.00 |
| August | 2,750 | 2,700 | 700 | 445 | 324 | 114.90 |
| September | 1,950 | 2,150 | 500 | 383 | 324 | 126.37 |
| October | 1,250 | 1.000 | 300 | 238 | 198 | 77.53 |
| November | 2,350 | 3,100 | 800 | 378 | 283 | 114.97 |
| Total | 23,750 | 21,100 | 5,100 | 3,818 | 3,769 | 1,170.77 |
| Average per stump | 6.22 | 5.52 | 1.33 | ..... | 0.987 | 0.3066 |
| Average cost in cts. | 19.76 | 2.37 | .87 | ..... | ..... | ..... |

The average cost of the removal of each stump is shown below:—

| Powder. Cents. | Fuse. Cents. | Caps. Cents. | Labor. Cents. | Total. Cents. |
|---|---|---|---|---|
| 49.76 | 2.37 | 0.87 | 30.66 | 83.66 |

The average cost of the materials used was as follows:—Powder, per pound, 8 cents; fuse, 100 feet, 43 cents; caps, per 100, 65 cents.

### Cost of Various Methods of Clearing Land.

It has been a difficult matter to get definite figures on the cost of clearing land by the different methods in use, chiefly because those who have cleared land have not kept detailed records. Often the cost can not be determined because included with other work.

TABLE II.

| Kind of land. | Method. | No. of acres. | Pounds. of powder. | Cost of labor | Cost per acre. | Remarks. |
|---|---|---|---|---|---|---|
| High Land | Donkey engine | 40 | 7,500 | ..... | $218.00 | Grubbing included. |
| " " | " " | 100 | 1,200 | $ 479.32 | 116.60 | 48 stumps per acre. |
| " " | " " | 5 | 1,000 | ..... | 90.00 | Stumps only. |
| Valley land | " " | 20 | 4,550 | 1,600.00 | 105.00 | |
| Bench land | " " | 10 | 900 | 1,010.30 | 123.00 | Heavy clearing. |
| " " | Powder and grubbing | 1 | 400 | 80.00 | 138.00 | Large fir-stumps. |
| " " | Powder & stump puller | 6 | 900 | 205.00 | 50.00 | Cedar and fir stumps. |
| " " | Donvey engine | 1 | 300 | 60.00 | 100.00 | Spruce stumps only. |
| " " | Powder and team | 17 | 4,000 | | 105.00 | 18-in below surface. |

## COST OF FILTERING WATER.*

The city of Fredericton, N.B., filter annually 200,775,770 gallons of water. The following was the cost during 1908:—

Number units, 3, with total capacity 1,251,000 gallons per day.

Cost of pumping and filtering water per 1,000 gallons, including interest, 10.1 cents.

Cost of filtering, including interest, 2.6 cents.

Cost of filtering 1,000 gallons, not including interest on capital account, 0.98 cents.

Amount coal used 1908 908.5 long tons.

Amount coal used per day, 5,555 pounds.

Including 500 pounds for electric light, 200 pounds for heating, 50 pounds for washing filters.

Making total for pumping day of 4,805 pounds.

## COST OF LAYING DUST WITH OIL.

### Some Experiments on Toronto Streets.

**Charles Sheard, M.D., Medical Health Officer, Toronto.**

We have been conducting experiments with crude oil on our city streets for about one month, and on the whole the experiments have proven satisfactory. We have employed two varieties of this residue, and, so far, that obtained from the British American Oil Company, I think, is the preferable oil. I may say in this connection that varying localities will have different opportunities for securing an oil more or less free from smell. Thus, for instance, if Texas crude be employed, it has many advantages which the simple petroleum residue has not. It is comparatively odorless, and is to some extent miscible to water. This, however, we could not use here because of our difficulty in securing a plentiful supply, and also on the ground of expense. In Pennsylvania they have some varieties of petroleum residue which are practically odorless; that, I believe, produced from the neighborhood of Oleon is of this character. Nevertheless, the oil we are using has little to complain about regarding the odor, which soon dies away after its application. Generally, after five or six hours the odor is entirely gone. The method of application is to apply the oil in several relays, with a few days between. The number of applications required will vary somewhat according to the road to be treated. If the road is a reasonably good one, free from ruts and not subject to very heavy traffic, three applications of oil should last three months. If, however, the road is a bad one, full of ruts, and subject to being traversed by heavy drays and waggons, it will probably not last longer than one month. The better the roadbed, the lighter the dose required. If it be simply a sandy, mud road, with a thick covering of several inches of flour-like dust, then a heavy first dose of oil is preferable, the idea being that the admixture of oil and dust will form a coating upon the surface of the road to which the dusty particles adhere. If the road has a considerable grade, and is much exposed to the sun's rays, the oil will dry out sooner than it would if the road happened to be more or less shaded by the trees. The method of application consists in lightly sprinkling the streets from a watering cart driven at a pretty rapid gait over the surface of the road, endeavoring to so deposit the oil that the spots of oil will be more or less separate, care being taken not to leave puddles of oil in the depressions or channels. Should such occur it is advisable to have a man with a broom to broom these away, so that they will not be splashed by traffic or stain the clothing of pedestrians. The road is then watched for three or four days, when the second dose is given and then allowed to rest for a while, and after a week or so the third application is made. The road is better for being prepared, channels being cleaned out, depressions levelled, and ruts more or less filled up. This, however, is not always practical, and the road may be treated without such preparation. We have found that upon ordinary roads 1,500 gallons per mile will complete the three applications specified above, and ought to maintain the road for at least from one to two months. This at four cents a gallon would be $60, and the cost of application from $10 to $15. This is probably less than the cost of sprinkling. A mile of road sprinkled twice a day would cost for labor alone $1 a day at least, which would leave the road more or less muddy. It would not be dustless for more than a couple of hours, and in some cases, if very dusty and sandy, a mile of road, or little more, would require the constant attention of a man and horse and watering-cart. Should the road be in good condition and in close proximity to other roads, the man would probably do a mile of road in an hour, and $1 a day would provide for two sprinklings per day.

Whn the cost of a large area of macadam road is considered, I think the oil would not be more expensive than the cost of sprinkling. On roads that are not much frequented by heavy traffic I consider the oil application would be exceedingly serviceable and comparatively inexpensive as a dust reducer. In setting forth the above facts as I have formed them in connection with work in the city of Toronto, I am free to admit that there is yet considerable investigation required as to the cheapest and best application to be employed. Preparations of tar have been used in the city of Boston, a mixture of oil, soap and tar in some places, and in other localities various oleaginous residues capable of a more or less admixture with water. However, they are, I think, apt to dry out more rapidly than the pure oil.

The Dominion Coal Company's output for the first six months of the year is 1,618,470 tons, against 1,922,236 tons last year, and 1,736,051 tons the year previous.

* From information supplied by A. K. Grimmer, B.A.I., City Engineer, Fredericton, N.B.

# METHODS OF SEWER CONSTRUCTION IN CLINTON, IOWA.*

By Charles P. Chase, City Engineer.

The largest piece of construction according to the sewer plans for Clinton, Iowa, described in previous articles, has been in District No. 4.

A contract was let in the fall of 1905 for about four miles of the mains in this district along the lines of the old water courses. Actual work began in December, 1905, and continued to April, 1908, when the last pipe was laid. The contractors carried on the work, winter and summer, rain or shine, night and day, for 801 days out of 820, never closing down the work but one day, which was in respect to a deceased relative. But it was a job where you could not stop. Water, mud, quicksand and rock was the programme. The Mississippi River came up the second month and had to be kept out for over a year, a bulkhead being constructed and the water pumped over with a centrifugal pump. In addition to this there were innumerable springs and several miles of house sewers emptying into the old drain that had to be taken care of. Nearly all the work was sheeted, and out of 23,000 feet there was but 1,000 feet of dry work, and that on smaller side lines. At one time two centrifugal pumps, three steam siphons, four diaphragm pumps and numerous

**College Avenue Sewer, Indianapolis, Ind.**
I. Completed Invert and Completed Arch, with Centre Ready to Move.

buckets were at work in a 400-foot length of trench for a month before it was drained. The average depth of trench was twelve feet, and water was generally found at two feet. Most of the water came through gravel or the seams in the rock, and was shut off by draining the gravel below grade or in the rock at times by actually caulking with cement sacks. Small amounts were shut off with dry concrete, or the various other devices known to the trade.

Steel Forms.—The first block of ten-foot sections was put in with wooden forms. After this steel forms were used with much better results. These steel forms are a great advance for good construction, and, the writer holds, are as much ahead of wood as the modern breech-loading gun is ahead of the muzzle-loader of our fathers. The steel form is quickly placed, can be taken down in a few minutes, leaves smooth, hard, glossy work, and is the only form for cold weather, as it radiates heat applied and keeps the concrete warm. Forms were greased every time they were used. After this experience I do not want any other forms for either brick or concrete. In the large sections, particularly the arch shapes, the concrete sewers were a great success, and I believe were better adapted to the adverse conditions than any form we could have used, especially in the winter work. But in the small work I would advise vitrified brick for the invert; in fact, use a vitrified brick for inverts in all small work (below four feet) where there are water or existing sewers to contend with. As to concrete in general, the writer never discovered any gray hairs before this work, but there were plenty when the job was finished.

Concreting in freezing weather was carried on without difficulty and successfully. Many methods were tried to heat the gravel used as an aggregate, and finally the method of a steam jet was found best, the steam pipe being thrust into the pile. This wet heat gave excellent results. The water was warm, and salt was used when the temperature was below ten degrees above zero. As soon as the concrete was in place it was covered with manure or canvas, sometimes both, and coke heaters kept going all the time inside. I made up a set of instructions, which were issued to my assistants and inspectors and the contractor's foreman for work in freezing weather, which I give herewith with the hope that it may be of benefit.

### Sewer Construction in Freezing Weather.

Use warm water and heated sand or gravel.

Use one pail salt to each barrel of water in all mortar on pipe and brick sewers.

Use less water than ordinarily, and mix all mortars as dry as can be efficiently used.

Only plaster in middle of the day, and see that frost is out of brick, and if not, take it out with water or steam jet, otherwise plaster will not stick.

Cover all joints in pipe work or masonry as fast as laid with dry earth or other material to protect from frost.

On concrete sewer, for the bottoms use salt in water, heated gravel and but small amount of water on cold days and tamp in place, and finish with top coat. Put such work in between hours of 10 to 12 a.m. if possible.

As soon as laid protect from weather by covering with manure or straw and placing canvas or tarpaulin over this; or when steam can be used excellent results can be obtained by covering with tarpaulin laid about 18 inches above the work and turning in small amount of steam. Do not turn on steam too strong, but just enough to keep warm. Empty bags over straw are also a help if tarpaulin is not handy.

Be sure all ice and dirt are removed before placing side walls on bottom or arch on walls, otherwise there will be no bond.

Keep stoves or salamanders going on inside of all concrete sewers.

Cold makes cement set slow, and freezing and thawing of water in concrete before final set will ruin it.

### Excavation.

It is much cheaper to thaw out ground with fire or steam than to pick frost.

Watch frozen banks for caving when frost goes out. It will drop all at once.

In back filling frozen ground allow 20 per cent. more shrinkage than when dry. (This does not apply to rock.)

Cover all work as fast as laid with unfrozen earth, if possible.

Back fill and clean up as close to work as possible before excavating materials freeze.

Chas. P. Chase,
Engineer in Charge.

(Please add what your experience suggests or what may arise from time to time.)

The issuing of these instructions seemed to awaken more interest in the work and cause the men to discuss the matter and think about it, with the result that several valuable suggestions were made and changes followed accordingly. I believe I am justified in saying that if any of you

* From a paper before the Iowa Society of Engineers.

will follow these instructions you need not fear work in cold weather. In two winters we lost no work on account of freezing, and only had two bottoms of twelve feet each that needed touching up. The steam jet was especially useful.

The materials used for concrete were clean-washed river gravel, containing in its natural state just about the right amount of gritty sand and Portland cement. Every car of cement was tested for tensile strength, pat test, boiling test, and action in water and on the work. During the work three cars of cement, about 600 barrels, were rejected. In two of these the cement hardened slowly and required a large amount of water and watching to keep it from slacking and going to pieces; the third car fell down all around. A record was made of the tests, of which there were over a thousand, but such tests are now so common I will not reproduce them here, but simply mention it to show the value of testing. The amount of water was watched and varied according to the practical demand of the actual conditions, varying from "no water concrete" to "slop." When using reinforcement we found it almost impossible to use a tamped "dry mixture," so called, as the spring of the metal dislodged the concrete. The best results were obtained by using the mixture as wet and soft as it would stand, pounding down with shovels and smoothing off. Inside, the steel forms gave a finish like glass. The bottom was kept well ahead of the top, so it was usually hard when the arch forms were moved. Mixing was done with Foote continuous automatic mixers,

**College Avenue Sewer, Indianapolis, Ind.**
II. Shallow Trench, Showing Stages of Work.

and we experienced no trouble in keeping proportions if the machine was kept clean. In fact, I liked their work better than the batch mixer on the job. Only one arch fell during construction, and this was when a "wise" foreman dumped several tons of mud from six buckets about twenty-five feet drop on a green arch. It not only wrecked the arch, but the steel form under it. No need to say it did not happen again. On brick and pipe sewers as well as the concrete we endeavored to mix practical "horse sense" and reason with our instructions, according to conditions and what our experience had taught would give best results. In an injunction law suit that developed (and failed) during construction, an engineer for the "kickers" testified that we were not measuring the ingredients (it was an automatic self-proportioning machine), and that on the brick work they were not wetting invert brick (in water and quicksand) where we had to build wooden cradles to start. I mentioned this brick testimony to the Italian bricklayer. He said: "Wetta hell; before I lay two brick they are so wetta they slida on my foots." Crude, but a world of truth; with no diploma, but perhaps nearly all of us in our blind younger days in commendable enthusiasm to follow the exact, hair-splitting terms of the modern specifications have "strained at a gnat" and frequently "swallowed the camel."

Owing to the extreme scarcity of labor much machinery was used on the contract. In fact, it was a "machine job." Excavation was done with steam shovels, Carson bucket machines, Parsons excavators, by teams, and by hand. The steam shovels were not a howling success in excavating, owing to the narrow ditches and not being able to blast heavily on city streets, but (take note) as the excavation was nearly half rock, in back filling the steam shovels did excellent work, which would have been impossible by team, and bankruptcy by hand. In the rock where the walls had to be close trimmed, the bucket machines made the best time, as they obtained a much cleaner ditch, completed as they went along. Both steam and air drills were used, steam being the most satisfactory, but the air drills were handy in trimming up. But for the heavy work they were not in it However, the air was utilized (take note) in blowing out the holes, freeing them from all dirt and water and in cleaning of concrete, cleaning rock, etc. The Parsons machine unfortunately got on the job in the winter with two feet of frosty macadam on the street where it was tried, which stuck it, and its next job was too soft and sticky, but when they struck the only dry earth on the job, it went along like an automobile.

**College Avenue Sewer, Indianapolis, Ind.**
III. Detail of Shallow Trench Work

The main items of contractors' plant consisted of the following:—

Two steam shovels.
Two Carson bucket machines.
One Parsons excavator.
One air compressor plant with air drills.
Two steam drill plants, ten drills.
Four concrete mixers.
Four extra steam boilers on trucks for warming materials and thawing ground, etc.
Two centrifugal pumps.
Four steam siphons.
One duplex pump, one pulsometer.
Four hand pumps.
Ten to twenty teams with dump wagons.
Hand tools, shovels, picks, etc.
Complete blacksmith and repair shop.
Cement warehouse.
Estimated value, $30,000.

The contractors were the Peoples Construction Company, of Davenport, Iowa, and they were always fair and quick to execute any proper orders, and carried out the letter and spirit of the contract to the best of their ability with but little friction and much to the satisfaction of the engineer.

This constitutes about four miles of work at a total cost of $180,000, exclusive of plant, general costs and interest, legal expenses and damages amounting to $10,000. Cost of engineering was about $5,000. These costs are according to "force accounts." The contractor lost heavily owing to the excessive rains, high water in the river, high wages and scarcity of labor, and also that the old drains were so obstructed that the soil was saturated to the limit. The bid of the contractor was $165,500.

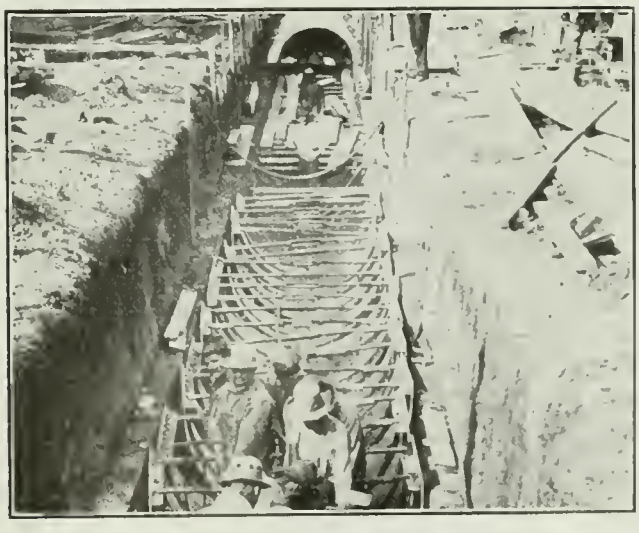
Cost of the Work.—Complete cost data were kept of the of inspectors, who kept force account on specially prepared work in sections from start to finish. All work was in charge blanks in book form. I give below the approximate costs:—

| Description. | Length, feet. | Size, Feet and inches. | Cost, per foot. |
|---|---|---|---|
| Steel and concrete, earth section | 1,700 | 6 ft. 3 in. x 10 ft. | $20 00 |
| Steel and concrete, rock section | 380 | 6 ft. 3 in. x 10 ft. | 15 00 |
| Steel and concrete, rock section | 1,360 | 6 ft. 3 in. x 9 ft. | 10 00 |
| Steel and concrete, rock section | 372 | 5 ft. 9 in. x 8 ft. | 10 00 |
| Steel and concrete, earth section | 500 | 5 ft. 9 in. x 8 ft. | 11 00 |
| Steel and concrete, circular | 1,040 | 66 in. | 6 00 |
| Plain concrete, rock section | 400 | 5 ft. 3 in. x 7 ft. | 6 50 |
| Plain concrete, earth section | 400 | 5 ft. 3 in. x 7 ft. | 7 00 |
| Plain concrete, earth section | 600 | 5 ft. 3 in. x 6 ft. | 7 00 |
| Plain concrete, rock section | 200 | | 6 00 |
| Plain concrete, earth section | 300 | 4 ft. 6 in. x 5 ft. 6 in. | 5 90 |
| Plain concrete, rock section | 510 | | 5 50 |
| Plain concrete, earth section | 810 | 4 ft. 3 in. x 5 ft. | 5 00 |
| Plain concrete, circular | 376 | 60 in. | 5 00 |
| Plain concrete, circular | 376 | 57 in. | 4 70 |
| Plain concrete, circular | 376 | 51 in. | 4 30 |
| Plain concrete, circular | 786 | 42 in. | 4 00 |
| Plain concrete, rock section | 1,050 | 40 in. | 4 50 |
| Plain concrete, rock section | 340 | 40 in. | 4 60 |
| Two-ring brick, circular | 800 | 48 in. | 6 00 |
| Two-ring brick, circular | 480 | 40 in. | 5 25 |
| One-ring brick, circular | 400 | 42 in. | 4 00 |
| One-ring brick | 1,200 | 30 in. x 45 in. | 4 50 |
| One-ring brick | 800 | 26 in. x 39 in. | 4 00 |
| One-ring brick | 400 | 28 in. x 42 in. | 4 20 |
| One-ring brick | 410 | 22 in. x 33 in. | 4 00 |
| Vitrified pipe, kiln run | 1,417 | 36 in. | 4 21 |
| Vitrified pipe | 2,077 | 30 in. | 3 53 |
| Vitrified pipe | 1,321 | 24 in. | 2 20 |
| Vitrified pipe | 820 | 22 in. | 2 10 |
| Vitrified pipe | 1,871 | 18 in. | 1 40 |
| Vitrified pipe | 200 | 12 in. | 80 |
| Catch basins, complete | .... | 153 | each 25 00 |
| Catch basins, connecting pipe | 3,973 | 10 in. | 45 |
| Manholes, complete | .... | | each 30 00 |
| Protection bulkhead, complete | .... | | 300 00 |
| Rip-rap, per sq. yd. | .... | 2,500 yds. | 1 00 |
| Extra concrete, under railways, per cu. yd. | .... | | 8 00 |
| Rock excavation, per cu. yd. | .... | 18,600 yds. | 2 00 |
| Rock disposal | .... | | 50 |
| Vitrified drain tile | .... | 23,872 ft. 8 in. | 25 |
| Timber left in trench by order of engineer, per M ft. | .... | | 30 00 |

Extra Work.—When the work was commenced it was freely predicted by enemies of the project that there would be an enormous bill of extra work, but the conditions had been so carefully examined and provided for in the plans that there was practically no extra work, the final estimate being a few dollars less than the original bid.

The work was paid for by bonds of $140,000 voted under the laws for changing water courses, and an abutting property tax of the balance according to benefits. The whole construction was carried on under the writer's direct supervision, and I personally endeavored to go "over the line" once each day to watch progress (and there was plenty to see). An instrument party attended to the lines and grades and an inspector was in charge of each point of construction. The project as above contracted for was first started by the writer nineteen years ago, and it took eighteen years to see it finished, but it is done, and the haunts of the duck and mosquito are destroyed, the domestic relations of the muskrats are disrupted and broken, the turtle's trail is obliterated and he wets his back in new pools, cellars are dry, sidewalks no longer serve as ferries, and, as one old fellow told me: "You've nearly dried me well; it is twelve feet to water and it used to be two, and I want damages." Let us hope that the malaria and typhoid have sunk with the water.

In the fall of 1907 and early winter of 1908 the detail plans for the balance of District 4 were ordered and completed, calling for about 12 miles of brick, brick and concrete, and pipe sewers. Bids were received in March, 1908, the low bid being $179,800, but owing to a political fluke part of the work was cut out. The conditions found in this second contract are worthy of note as showing the benefit



**College Avenue Sewer, Indianapolis, Ind.**

IV. Showing Assembling of Centres for Extension of Invert.

of the first work. Where last year it required centrifugal pumps and constant exertion and watchfulness to keep the water down enough to work, the ground is now thoroughly drained and dry to a depth of nine feet, and this has been the case over several miles of ditches.

## THE FORCING OF FIRE TUBE BOILERS.

In a recent paper F. W. Dean, mill engineer and architect Boston, Mass., undertakes to show that the prevailing opinion upon the relative forcing capabilities of the fire and water tube boiler is incorrect, and in support of this claim gives particulars of several boiler tests. Mr. Dean begins his discussion with the statement that there is a widespread impression among many persons interested in boilers that the fire-tube type of boiler has less capacity to be worked above its rated power than boilers of the water-tube type, and that it is necessary to provide such boilers with more heating surface per horse-power than water-tube boilers require. It is pointed out that for many years it has been customary to base the horse-power of horizontal return tubular boilers upon 15 square feet of heating surface per horse-power, although at present some makers of this boiler venture to place it upon 12 square feet.

It is important to remember that the rating of 15 square feet was in use long before the A.S.M.E. established the meaning and measure of a boiler horse-power, and by persons who probably knew very little about boiler performance and the capacity of heating surface to absorb heat. It probably had been found at some time, that, with the prevailing type of engine in use it was always safe to provide boiler power upon this basis. It had not been customary to make boiler tests at that time as frequently as now, and no exact knowledge of boiler performance existed, or, if it did, it was confined to comparatively few persons.

The introduction of water tube boilers had caused more intelligent study of boiler phenomena, and there are now associated with the builders of this type of boiler many of the brightest men and most energetic salesmen.

Mr. Dean continues, "Before proceeding with the details, however, I will briefly mention the reasons given for the alleged superiority of the water-tube boiler in the respect under consideration. It may also be well to state what is meant by ability to stand forcing. In a general way this ability is the capacity to evaporate much more water than the rated power of the boiler would require. This amount is often 20, 50, or even 100 per cent. in excess of the rated requirements, and depends upon the amount of fuel consumed in a unit of time. This in turn depends chiefly upon the draft in the fire-box and the freedom with which air can pass through the gate or stoker and through the fuel itself.

An alleged reason for the superiority is that the water-tube boiler contains less water than the fire-tube boiler, by which is meant, I suppose, that it contains less water in proportion to the heating surface. I have been able to ascertain the amount of water contained by a few water-tube boilers, and have computed that contained by several fire-tube boilers, drawings of which I have. The results are as follows:—

| | Lb. per sq. ft. of heating surface. |
|---|---|
| Horizontal water tube boiler A | 7.66 |
| Horizontal water tube boiler B | 8.34 |
| Horizontal water tube boiler C | 8.62 |
| Horizontal water tube boiler D | 8.37 |
| Vertical water tube boiler | 10.30 |
| Semi-vertical water tube boiler | 11.42 |
| 90-in. horizontal water tube boiler | 7.74 |
| 84-in. horizontal water tube boiler | 7.24 |
| 78-in. horizontal water tube boiler | 7.00 |
| 72-in. horizontal water tube boiler | 6.73 |

| | Lb. per sq. ft. of total surface. |
|---|---|
| Manning vertical tube boiler | 7.14 |
| Corliss vertical tube boiler | 11.00 |

Some vertical boilers of my own design contain more water than the Corliss.

An inspection of this table as far as it goes shows that water-tube boilers generally contain more water than horizontal fire-tube boilers. It appears from this that whatever advantage accrues from small water contents lies with the horizontal return tubular boiler. The vertical water-tube boiler, as well as some designs of fire-tube boilers, contains more water than horizontal boilers.

The comparison of horizontal boilers reveals conditions that should not be surprising, for water-tube boilers are made up of drums, headers and tubes, all of which contain considerable water, while the horizontal return tubular boiler has most of its water space filled with tubes, especially when there is no manhole in the front head below the tubes.

A little consideration will show, however, that the quantity of water contained by a boiler has no effect upon forcing capacity after steam is once up to the working pressure. The reason for this is that heat added cannot raise the temperatiy of steam formed and increase the quantity and temperature of the escaping gases. It, therefore, appears that both types of boiler have equal merits in this respect.

Another claim is that as the flame enters among the tubes of water-tube boilers the evaporation is forced more than if it did not reach them. As flame is combustion in process, and is likely to be prematurely terminated by contact with the relatively cold surfaces of the tubes, it is apparent that it is disadvantageous to have the flame pass among the tubes.

Another claim is that the hot gases impinge against water-tubes, and, therefore, give up more heat than they would if they passed parallel to them. The fallacy of this argument is apparent when it is remembered that gases give up heat because their temperature is higher than that of the heat receiving medium, and not because they are thrown against this medium. Moreover, some kinds of water-tube boilers compel the gases to move parallel to the tubes, and this feature is held to be highly advantageous by interested persons. Incidentally it will be found disadvantageous to project boiler gases against the outside of tubes, for examination shows that it causes wedge-shaped accumulations of soot at the very part of the tubes where the greatest reception of heat was expected, thus rendering this part the least effective of any.

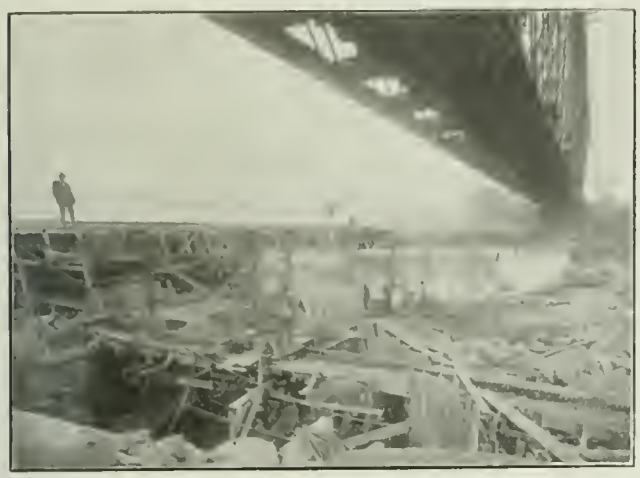
I believe it is also claimed that there is less reduction of draft between the smoke flue and the fire box in water-tube than in fire-tube boilers on account of larger spaces between the tubes of the former than through the tubes of the latter. Whether this is true or not I cannot say in general, but in cases where I have determined it the results are inconsistent and contradictory. I have found, however, that the vertical fire-tube boiler requires the least draft for burning coal at a given rate. This, I think, is due to the path of the air being at right angles to the fuel and, therefore, shorter and less impeded by the fuel than with horizontal boilers, in which the path of the air is diagonally through the fire."

## METHOD OF CONSTRUCTION OF THE NEW DAM AT BELLOWS FALLS, VERMONT.

The old wooden crib dam across the Connecticut River at Bellows Falls has recently been replaced by one of concrete, in the construction of which unusual efficiency was secured through the use of special equipment and methods. This dam, which was designed by Charles T. Main, of Boston, Mass., who acted as consulting engineer, joins the Vermont and New Hampshire Shores. In the effort to economize material and utilize outcropping ledges for footings the dam was made to follow a somewhat zigzag course, its total length being about 600 feet.

The contract was let to the Aberthaw Construction Company, Boston, Mass., who began work in July, 1908, and was completed in about four months.

The dam is of very irregular cross section, the crest, of course, remaining the same throughout its entire length, but the base varying with the depth of the river bed. At the maximum it is 38 feet deep. It changes direction five times.



**Down Stream Side of Bellows Falls Dam.**

The down-stream face of the old crib dam served to some extent in place of forms in placing the concrete. Elsewhere matched spruce was used. The concrete was mixed in the proportion of 1:3:5. Almost 80 per cent. of the crushed stone was brought down to a size that would pass through a 2-inch screen. Rubble stones were at least one cubic foot in volume.

In the construction of the mixing plant which was designed by the contractors a platform was provided for receiving the wagon loads of sand and stone, and connecting therewith were a cement runway, chutes for sand, gravel and stone. Power was furnished by a 35 horse-power motor. A centrifugal pump supplied water for washing, and a 21 cubic foot Smith mixer delivered concrete by gravity into Koppell dumping cars. These cars run from one end of the dam to the other on a 24-inch track, supported on a timber trestle about 4 feet above the crest. Beneath the upper platform pockets were provided for gravel and stone which was received through chutes. Through the medium of these pockets, which were built in the correct ratio of volume, the proper mixture was insured, the bags of cement being emptied into the mixer from a special platform.

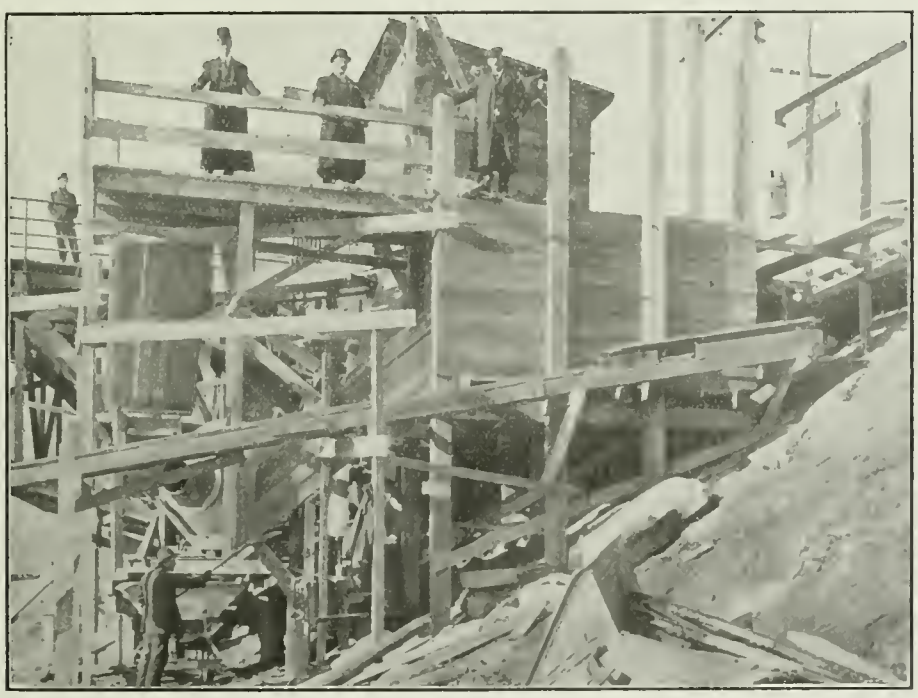
Gravel and sand were taken from a pit about one-eighth of a mile away, and stone from a quarry at a distance of three-quarters of a mile. Gravel was handled at the pit by a ½ cubic yard orange peel bucket in connection with a derrick having a 70 foot boom and 40 foot mast. The contractors maintained a screening plant at the gravel pit. All sand and stone were carted to the mixing plant.

The working gang averaged about 125 men. The cost of labor per cubic yard averaged about 12 cents at the mixer. A total of about 15 cents per cubic yard was chargeable to the original cost of the mixer plant and the electrical operation of the mixer, and about 30 cents per cubic yard to transportation, dumping and placing. The form work cost approximately 9 cents per square foot of surface contact.

The concrete was deposited along the top of the dam by means of the cars which were propelled by hand. It was dumped into chutes leading to the base of the dam and there spread by laborers.

Coffer dams were required throughout most of the work, particularly on the Vermont side where the greatest trouble with water was experienced. These were generally built of 12 inch logs, bolted together with cross logs 10 ft. on centres. These coffer dams, which were constructed as rafts, were towed out into the stream and there sunk to the level of the dam foundation. Four-inch spliced and grooved sheeting was driven to a firm foundation by a maul. It was then withdrawn and trimmed if necessary for the final driving to bed rock.

The work was done in sections with bulk heads installed at right angles to the general direction of the coffer dam work, parallel to the face of the dam. After the completion of the concrete work dynamite was employed to blow up the crib work. A derrick was first employed to remove the stones which were previously used to sink the crib. The total amount blasted out of the river bed in the preparation of the dam footings was about 300 cubic yards; the total amount of concrete was about 5,250 cubic yards. The aggregate cost of the work, including forms, coffer dams, pumping and incidental charges, was approximately $43,500.



**Mixing Plant.**

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. Prtsident, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**National Irrigation Congress.**—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

**League of American Municipalities.**—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé, R.S.A.; P.O. Box 259, Montreal, Que.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

ST. LOUIS.—Tenders for street paving in asphalt and paving blocks will be received until the 20th inst. J. Emile Vanier, Town Engineer, 5 Beaver Hall Square, Montreal.

**Ontario.**

COCHRANE.—Tenders will be received until July 21st for the construction of a union station. A. J. McGee, secretary-treasurer, Temiskaming and Northern Ontario Railway Commission, 25 Toronto Street, Toronto. (Advertised in The Canadian Engineer.)

LONDON.—Tenders will be received up to Saturday, July 24th, for construction of the Scanlon drain, London East. F. W. Farncomb, Township Engineer.

MIDLAND.—Tenders will be received up to Monday, the 26th July, for the construction of approximately 20,000 lineal feet of concrete walks. Thos. I. Trueman, Town Clerk.

NORTH BAY.—Tenders for the erection of a court house at Kenora and an addition to the court house at North Bay, heating, plumbing, and for lighting electric fixtures for the Normal School, North Bay, will be received until Friday, the 23rd July. H. F. McNaughten, Secretary, Department of Public Works, Toronto.

OTTAWA.—Tenders will be received up to August 15 for the furnishing of iron posts for use on the survey of Dominion lands. P. G. Keyes, secretary, Department of the Interior.

OTTAWA.—Tenders will be received until Friday, July 23, for the construction of a building for refinery, Royal Mint. Napoleon Tessier, secretary, Department of Public Works.

PETERBOROUGH.—Tenders will be received up to Saturday, the 17th July, for the construction of abutments for the steel bridge over the Indian River. Plans and specification may be seen at the office of the County Engineer, J. E. Belcher. Ed. M. Elliott, County Clerk, Peterborough.

PETERBOROUGH.—Tenders will be received up to the 17th July for the steel work of a bridge over the Indian River, 75 feet span from abutments' faces at water level. County Engineer, J. E. Belcher. Ed. M. Elliott, county clerk.

PETERBOROUGH.—Tenders for the erection of Knox Church will be received up to Monday, July 19th. Secretary Building Committee, 283 Park Street.

PETERBORO'.—Tenders for grading, sodding, drives, concrete and stone work, drill hall, will be received until Wednesday, July 21st. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

RAINY RIVER.—Tenders will be received until July 28th for pipelaying, pumping machinery and other waterworks equipment. Jas. A. Bell, Consulting Engineer, St. Thomas, Ont. J. H. Wilson, Town Clerk. (Advertised in The Canadian Engineer.)

TORONTO.—Tenders will be received up to Tuesday, August 3rd, for the construction of reinforced concrete arch of 35-foot span, having a 42-foot roadway, and two 6-foot sidewalks, containing about 1,500 cubic yards of concrete. Joseph Oliver (Mayor), Chairman Board of Control.

TORONTO.—Tenders will be received until July 28th for the construction of transformer and interswitching stations at Toronto and other points in Ontario. Hydro-Electric Power Commission, Continental Life Building.

**Manitoba.**

BIRTLE.—Tenders will be received until July 23rd for the construction of a bridge five miles south-west of Birtle. Tenders may be for cement piers and superstructure, separate or combined. Plans and specifications may be seen at the Department of Public Works, Winnipeg. T. W. Thompson, Secretary-treasurer Birtle Municipality.

BRANDON.—Tenders will be received up to July 17th for a supply of creosote wood paving blocks for bridge paving. Price to be per yard f.o.b. Brandon, duty paid. Harry Brown, city clerk.

KILLARNEY.—Tenders will be received until Saturday, July 17th, for the erection of a municipal hall building. Plans and specifications will be on file at the Builders' Exchange, Winnipeg. George G. Teeter, Architect, 604 Builders' Exchange, Winnipeg.

PIPESTONE.—Tenders for the construction of two steel bridges with concrete abutments will be received up to the 17th July. Plans and specifications can be seen at the offices of the Chief Engineer, Public Works Department, Winnipeg. A. P. Power, Secretary-treasurer, Virden P.O.

WINNIPEG.—Tenders will be received up to Monday, July 26th, for the supply of 1,000,000 feet of B.M. lumber. M. Peterson, Secretary, Board of Control.

WINNIPEG.—Tenders for supply of twenty-two 8-inch and ten 5-inch valves for waterworks system will be received up to July 21st. M. Peterson, Secretary, Board of Control office.

WINNIPEG.—Tenders will be received until August 2nd and August 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chace, engineers, Winnipeg; William Kennedy, jr., Y. M. C. A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

**Saskatchewan.**

FRANCIS.—Tenders will be received until Monday, July 26th for: (a) Furnishing material and constructing a concrete collecting basin, 25 ft. x 25 ft. x 18 ft. (b) Furnishing 9,750 feet 6-inch wooden pipe. (c) Furnishing 4,630 feet 6-inch cast-iron pipe, with necessary special castings. (d) Gate valves, valve boxes and soft lead. (e) Labor laying wooden and iron pipe. C. R. Gough, Secretary-treasurer.

MOOSE JAW.—Tenders will be received up to Monday, 18th July:—t-50 light, constant current transformer or regulator, with 35 arc lamps and suitable switchboard, with necessary instruments for controlling same; one year's supply of Watt meters; one' year's supply of transformers. John D. Simpson, City Clerk.

REGINA.—Tenders will be received up to Monday, July 19th, 1909, for the construction of reinforced concrete bridge abutments for several highway traffic bridges. F. J. Robinson, Deputy Commissioner, Department of Public Works.

REGINA.—Tenders will be received until July 19th, for a supply of sewer pipe. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for concrete pavements, curbs, and sidewalks. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for a supply of pipes and valves for waterworks system. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

SASKATOON.—Tenders are wanted for the construction of a subway under the C.N.R. tracks. Geo. T. Clark, City Engineer.

**Alberta.**

EDMONTON.—Tenders will be received until Friday, July 30th, for the construction of post-office, customs and inland revenue fittings. R. T. Manson, Clerk of Works, Edmonton. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

**British Columbia.**

VANCOUVER.—Tenders for post-office fittings will be received until Wednesday, July 21st. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

VICTORIA.—Tenders will be received up to Monday, 16 August, for the supplying of cast iron water pipe, pig lead, gate valves, for waterworks. W. W. Northcott, Purchasing Agent.

## CONTRACTS AWARDED.

**Ontario.**

ARNPRIOR.—Following is the list of tenderers for the bridge across the Madawaska River at Stewartville:—

| Name. | Superstructure. | Substructure. |
|---|---|---|
| Hamilton Bridge Company .... | $4,200 | ..... |
| Jenks-Dresser Co., Sarnia . ... | 5,075 | $7,000 |
| Dickson Bros., Cambellford .. | 4,925 | 5,072 |
| J. R. McQuigge, Arnprior .... | 4,975 | 4,995 |
| George A. Begy, St. Catharines ..... | | 5,945 |
| Western Bridge Co., Chatham.. | 3,250 | 6,750 |
| Edward B. Merrill, Toronto .. | ..... | 5,270 |
| McMannus & Co., Hamilton .. | 5,930 | 6,250 |
| Stratford Bridge Co., Stratford | 5,469 | ..... |

Contract for superstructure awarded to Hamilton Bridge Co.; contract for substructure awarded to Jenks-Dresser Co., Sarnia. Mr. A. L. McAllister, B.A.Sc., of Toronto, was the consulting engineer.

BLENHEIM.—R. Leitch, of Blenheim, has received the contract for the concrete sidewalks to be laid by the town at 10¾ cents a square foot.

SMYTHE.—Mr. A. L. McLennan, of Toronto, has received a contract for the construction of a waggon road from Smythe to Gow Ganda. The length of the road is about 27 miles and the contract includes chopping, clearing, stumping and grubbing.

TORONTO.—The controllers recently awarded to the Canada Foundry Company the contract for supplying 12 and 15-inch penstocks for $29.84 and $35.02, and to the John Inglis Company the contract for the 18 and 24-inch penstocks at $43.75 and $57.65. The penstocks are for the high level interceptor sewer.

TORONTO.—The contract for the concrete foundation and piers of the new wing of the Parliament buildings has been awarded by the Provincial Public Works Department to A. Gardiner & Company, Toronto. The contract price is $16,000.

NIAGARA FALLS.—The following figures represent tenders submitted for the sewers on Main Street:—

| | S. Critelli & Son. | P. Lorenzo. |
|---|---|---|
| Lump sum . ..... | $2,379 00 | $2,560 00 |
| Rock, per yard ..... | 3 50 | 3 50 |
| Manholes . . ..... | 60 00 | 60 00 |
| Catch basins . . ..... | 30 00 | 35 00 |

**Manitoba.**

WINNIPEG.—Mr. Moen, a Norwood contractor, will construct for the town of St. Boniface granolithic walks to cost $5,300.

**Saskatchewan.**

SASKATOON.—The tender of W. T. and J. Arrand for concrete sidewalks at 19¾ cents, 25 cents, 68 cents and 24¾ cents, was accepted.

PRINCE ALBERT.—Sewer and waterworks extension tenders were as follows:—

| | Extensions. | Catch Basins. |
|---|---|---|
| Bolton & Company .....* | $9,500 | $45.75 each |
| McVean & Craig . ..... | 9,837 | *42.70 each |

*Accepted.

The figures for extension were $1,450 below the engineer's estimate.

**British Columbia.**

VANCOUVER.—Tenders for supplying the city with an automatic ambulance which will be operated directly under council control were as follows:—Frank Darling, for Wilson & Stockhall, Old Country apparatus, $5,200; W. E. Seagraves, Walkerville, Ont., $5,600; W. J. Massey Company, $4,400; Storey & Campbell, Studebaker machine, $4,992, for 30 horse-power, and $5,708 for 40 horse-power; White Company, of San Francisco, steam propelled machine, $6,500. The contract was not awarded.

VANCOUVER.—Subject to the approval of the ratepayers, a contract amounting to $105,250 has been given to the Hassam Paving Company of this city. It includes: Paving Columbia Street, $53,000; cement sidewalks, $31,500; sewer system, $20,750.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

NOMINING.—This extension of the C.P.R., which runs from Nomining to Rapid l'Original, a distance of nearly 36 miles, is rapidly nearing completion, the Toronto Construction Company, who are grading, hope to have the line taken off their hands this month, preparatory to commencing operations in New Brunswick. The station at mile 12 (near village of Chemin Govin), a handsome structure of No. 5 pattern is completed, as also the single and double section houses. The latter would be a credit to a city. Work is being rushed at the 40,000 gallon tank at mile 19, and the station at mile 26 (near village of Val Barrette). This is also a standard station of No. 4 design. The tank, two stall engine houses, coal platform and station at Rapid l'Original while not yet commenced will be shortly, and completed be-

contractor for this work.

fore the 30th August. C. E. Deakin, of Montreal, is the

SHERBROOKE.—From Sherbrooke to Quebec has been completed a survey of the Quebec Eastern Railway, which measures 117 miles.

**New Brunswick.**

ST. JOHN.—Eleven new tracks, having an average length of 1,200 feet, are being laid in the C.P.R. yards at this point.

**Ontario.**

CHATHAM.—A deputation of English capitalists visited Chatham last week, and in company with John Piggott and other directors is making an inspection of the Windsor, Essex and Lake Shore Railroad. If they can be induced to put up the capital they talk of doing the road will immediately be extended to Chatham, and later it is the intention to build it on to London.

COCHRANE.—A union station of red pressed brick, with stone trimmings will be erected here this fall for the use of the T. & N. O. and the N. T. Railways.

GUELPH.—The Dominion Railway Commission has issued an order compelling the Grand Trunk to erect a new passenger station in Guelph before September, 1910. The company is also compelled to put in a subway at Gordon Street and a foot subway at Huskisson Street. There will be a subway at Neeve Street, the cost of which may be borne by the city or the company, whichever can prove the right of first survey over the property.

OTTAWA.—The Railway Commission recently issued an order to all railway companies requiring them to fyle with the Board by September 1st a detailed statement as to all level crossings on their lines of railway where accidents have occurred since January 1st, 1900.

OTTAWA.—The G. T. R. intends commencing work on new freight sheds of brick, 340 feet in length by 60 in width.

ST. MARY'S.—An extension of the C.P.R. from Code's Junction to Ingersoll will be commenced shortly.

TORONTO.—The Ontario Railway Board has approved for subsidy purposes of 66.16 miles of the Lake Superior Branch of the G.T.P.; 22 miles west of Fort William. The bonus is $2,000 and 3,375 acres per mile.

**Manitoba.**

WINNIPEG.—The telegraphone system, which the C.P.R. started installing on the Western lines last winter, has proved so successful between Fort William and Winnipeg, that the company has been continuing its installation with a view to equipping the entire line from coast to coast with the system. The system from Winnipeg to Brandon, and from Swift Current to Medicine Hat has been completed, and work will be continued on the other lines.

WINNIPEG.—The Pas Mission branch of the C.N.R., the first link in the road to Hudson's Bay, will be taken over by the operating department shortly. The final estimates on the construction will be ready to be turned over to the Government within the next couple of weeks, and will include figures for the cost of the work, quantities and grades of materials to be handled, together with maps and plans showing the final location and profiles of the two routes. At present there are two parties of engineers in the field. These parties recently made progress reports to headquarters, and it is expected that they will be ready to come out about the end of August.

WINNIPEG.—G. T. P. steel was within eight miles of Edmonton on Tuesday, and the last spike will likely be driven in a day or two. This will give four lines between Winnipeg and the capital of Alberta.

**Saskatchewan.**

INDIAN HEAD.—A gang of men has commenced preliminary work in connection with the construction of the new C.P.R. depot at this point.

PRINCE ALBERT.—Surveys have started on a branch of the G.T.P. from Watrous to Prince Albert.

REGINA.—The Canadian Northern has decided to construct a new main line to Edmonton, using their Winnipeg-Brandon-Regina route as the first section. From Regina the Prince Albert branch will be utilized to a point near Craik; from there a new line will be built crossing the South Saskatchewan at the Elbow and running northwesterly to Edmonton, and on to the Pacific.

REGINA.—James J. Hill has men surveying the Crow's Nest coal field district, north from Flathead County, Montana, and on July 6th there was filed with the Secretary of State a resolution by the directors of the Great Northern, announcing that company's intention to build northward into Saskatchewan.

**Alberta.**

EDMONTON.—The G.T.P. track laying gang is working night and day 18 miles this side of Tofield. Steel reached Edmonton last week. The G.T.P. will use C.N.R. lines from the packing plant in the northern part of the city for a couple of weeks until the line is completed to the centre of the city. They are now removing buildings and ballasting the right of way in the city.

**British Columbia.**

VANCOUVER.—The B.C. Electric Railway Company will shortly extend its line to Huntingdon.

VANCOUVER.—Boyd & Craig, of this city, have secured the contract for grading the Howe Sound, Pemberton Valley & Northern Railway proposed line from the head of tidewater on Squamish to Chee Kee Creek, 7½ miles. The work is to be finished by December 15th, and the ballasting will be completed by the middle of January. Surveys for the line between Anderson Lake and Lillooet, a distance of 50 miles, are now being undertaken.

VICTORIA.—Dixon & Moore, who have done much construction work on the Alberni Extension of the E. & N. Railway, have just been given a contract for another seven miles.

**United States.**

CHICAGO, ILL.—Steel street cars, the first to be used on surface lines in any city in America, will be placed in service within a few days here, by the Chicago Railway Co.

## CEMENT—CONCRETE.

**Ontario.**

BLENHEIM.—A contract for cement sidewalks has been given to P. Leitch of this town at 10¼ cents a square foot.

BRANTFORD.—A concrete culvert will shortly be built across Colborne Street by this city.

BROCKVILLE.—If the by-law passes, six concrete bridges, to cost (estimated) $15,715 will be built by this municipality. Mr. Frank Barber, York County Engineer, prepared the plans.

HAMILTON.—For the construction of cement sidewalks, debenture by-laws of Barton Township, amounting to $42,261.44, have been validated by the Ontario Railway and Municipal Board.

LONDON.—The Bell Telephone Company will place its wires underground, and 360 barrels of cement will be required.

MIDLAND.—Twenty thousand lineal feet of concrete walks will shortly be constructed here. Thomas I. Trueman, the town clerk, now asks for tenders.

OMEMEE.—Lake Bros., of Lindsay, have been awarded a contract for the building of three thousand four hundred feet of granolithic walk here.

OTTAWA.—The International Portland Cement Co. has declared a half-yearly dividend of five per cent. Up to June 30th the shipments of the company show the substantial increase of 22,285 barrels over the corresponding period of last year.

PETERBOROUGH.—Concrete will be used here in the construction of a drill hall, for which the Department of Public Works invites tenders until July 21st.

ST. THOMAS.—Cement will be used in the construction of a new reservoir at the waterworks here. James A. Bell is City Engineer.

ST. CATHARINES.—By-laws for the construction of cement sidewalks have been passed by this municipality.

TORONTO.—A reinforced concrete arch, which will require about fifteen hundred cubic yards of cement is to be erected by the city of Toronto over Beatrice Street. Mayor Oliver invites tenders for the work.

**Manitoba.**

BIRTLE.—Tenders are invited for cement piers for a bridge until July 23rd by T. W. Thompson, secretary of this municipality.

BRANDON.—Granolithic walks to cost $3,000 will be constructed by this city.

VIRDEN.—Two bridges, with concrete abutments, will be erected by the municipality of Pipestone as soon as tenders have been awarded. A. P. Power is secretary of the municipality.

WINNIPEG.—Contractor Moen, of Norwood, has a contract amounting to $5,300 for the construction of granolithic walks for the town of St. Boniface.

**Saskatchewan.**

REGINA.—Several highway bridges will be erected by the Saskatchewan Department of Public Works. F. J. Robinson, the Deputy Commissioner, invites tenders for the abutments, which are to be of reinforced concrete.

SASKATOON.—This city has given to W. T. and J. Arrand a contract for concrete sidewalks.

SASKATOON.—The Saskatoon Concrete Company will commence this week on a contract for the construction of walks.

**British Columbia.**

VANCOUVER.—Notice is given of the city's intention to make local improvements at a cost of many thousand of

dollars. Concrete sidewalks are responsible for the largest items.

VANCOUVER.—The Hassam Paving Company, of Vancouver, has received a contract for concrete sidewalks which will cost $31,500.

VICTORIA.—A fireproof office building, in which will be beams of reinforced concrete, will be erected here by the Royal Bank as soon as the contract is let.

## LIGHT, HEAT, AND POWER

**Ontario.**

NIAGARA FALLS.—Another rise of two cents per thousand feet in the price of gas was made by the Provincial Natural Gas Company, making the price 30 cents.

PETERBOROUGH.—The special committee appointed to negotiate with the Central Power Company with a view to acquiring Burleigh Falls power has decided that $50,000 is a fair sum, and that figure has been offered. The company asks $125,000.

WALKERVILLE.—One thousand steel towers for the transmission line of the Ontario Hydro-Electric Commission have been completed at the plant of the Canadian Bridge Company. Shipments have begun and will continue at the rate of 300 a month until the full order of 3,000 has been filled.

**British Columbia.**

VICTORIA.—In connection with the proposed arrangement between the city and the B. C. Electric Company, construction work will be commenced at Jordan River on a plant to develop 10,000 horse-power, at an estimated cost of $1,500,000.

## FINANCING PUBLIC WORKS.

The municipalities mentioned below have sold debentures:—

**Almonte, Ont.,** $15,000 street improvements,
**Brampton, Ont.,** $15,404 sidewalks and $50,488 sewers.
**Prince Albert, Sask.,** $83,300.
**Truro, N.S.,** $113,025 sewerage and waterworks system.

**Quebec.**

HULL.—The $112,000 which Hull wants for various civic improvements will be divided into five by-laws, including $52,000 for waterworks.

VERDUN.—The council are considering the advisability of securing a loan of $150,000; for electric light plant, $110,000; water mains, $10,000; bridges, $5,000.

**Ontario.**

AYLMER.—The by-law for the raising of $4,000 to build a bridge was carried.

COLLINGWOOD.—Debentures for sewers $57,694 and others, amounting to $14,300 are offered by this town. The clerk is J. H. Duncan.

HAMILTON.—The Ontario Railway and Municipal Board has validated a series of debenture by-laws of Barton township, totalling $42,261.44 for the construction of cement sidewalks.

HAWKESBURY.—D. Doyle, town clerk, invites tenders for sidewalk debentures amounting to $9,400.

LONDON.—The Township of Westminster has for sale debentures amounting to $5,000.

STRATFORD.—A by-law of $15,000 for an extension to the hospital carried.

VERDUN.—The proprietors of Verdun have offered no objection to the proposed loan of $150,000 for street and other improvements.

WINDSOR.—Tenders are invited by Stephen Lusted, clerk of this municipality, for $20,000 waterworks debentures and $19,000 school debentures, until the 21st July.

**Manitoba.**

DELORAINE.—Tenders are desired until August 1st by D. L. Livingstone, secretary-treasurer, for $5,500 local improvement debentures.

KILLARNEY.—This municipality has for sale $10,000 debentures, presumably to cover the cost of local improvements. Geo. B. Monteith is secretary-treasurer.

**Saskatchewan.**

WHITEWOOD.—Tenders will be received up to July 31st for $4,000 debentures for erecting a skating and curling rink.

**Alberta.**

RED DEER.—This municipality offers for sale $4,500 debentures. A. T. Stephenson, secretary-treasurer.

**British Columbia.**

KAMLOOPS.—On August 1st ratepayers here will vote on a by-law to raise $20,000 for waterworks extensions.

VANCOUVER.—The corporation of Burnaby offers for sale $150,000 road improvement debentures. C. T. Saunders, C.M.C., Drawer 10, New Westminster.

VICTORIA.—A by-law will shortly be submitted to the ratepayers of Victoria to provide $1,350,000 in connection with the city's offer to purchase the plant of the Esquimalt Waterworks Company.

## TELEPHONY.

**Ontario.**

LONDON.—The Bell Telephone will place its wires in this city underground at an estimated cost of $50,000.

**Saskatchewan.**

REGINA.—Announcement is made in the Saskatchewan Gazette of the incorporation of the following telephone companies:—Fairview Rural Telephone Company, Regina; Central Rural Telephone Company, Regina; Ellisboro' Rural Telephone Company, Ellisboro'; Rose Plain Rural Telephone Company, Regina.

REGINA.—Tenders have just closed with G. P. Porter, Deputy Commissioner of Telephones, for the construction of a line between Saskatoon and Prince Albert.

## SEWERAGE AND WATERWORKS.

**Ontario.**

GUELPH.—Last Saturday afternoon, for the first time, water from Arkell Springs, four miles distant, was used by the citizens of Guelph.

LONDON.—Until July 15th tenders were received for the construction of a number of sewers.

ST. THOMAS.—Dr. Amyot, of Toronto, Provincial bacteriologist, is investigating the waterworks system here. The growth of algae has blocked the filters and prevents proper filtration.

ST. THOMAS.—The Water Commissioners have decided to construct a new reservoir at the waterworks the same size as the present one. Plans will be prepared and the work begun as quickly as possible.

TORONTO.—Engineers will be appointed by the Ontario Government to look into the claims of the Cameron Septic Tank Company, of Chicago, relative to the infringement of their patent.

WELLAND.—The council have passed a by-law for the Myrtle Avenue sewer, which will require 350 feet of 15-inch pipe and 510 feet of 12-inch pipe, to be laid from 7 to 15 feet deep. Estimated cost, $1,420.

**Saskatchewan.**

FRANCIS.—This municipality desires tenders until July 26th for the construction of waterworks. C. P. Gough is secretary-treasurer.

**Alberta.**

RAYMOND.—The Town Council of Raymond will immediately engage an engineer to look after the installation of a waterworks system.

**British Columbia.**

FERNIE.—Broley & Martin have been given a contract by this city to lay a 12-inch pipe line from Farley Creek at a cost of $30,000.

NEW WESTMINSTER.—At a recent meeting of the council an important report on the proposed new intake for the city water supply from Lake Coquitlam was submitted by City Engineer Blackman and Consulting Engineers Hermon & Burwell, of Vancouver, which outlined a scheme for installing a substantial and permanent intake in the lake, the work to be carried out by the Vancouver Power Company, while that company is erecting the large new dam proposed at the outlet of the lake. The report of the engineers was adopted and the power company will be asked to furnish detailed drawings of the proposed intake, which will provide for a capacity of over 1,000 inches of water, while the city at the present time is using less than 100 inches. The plans also provide for an emergency intake which will be at a much lower level than the lake intake, so that in case of the water being particularly low in the lake on account of special reasons the second intake may be used.

VANCOUVER.—The council of South Vancouver are discussing the question of a new water by-law.

## MISCELLANEOUS.

**Ontario.**

BROCKVILLE.—Mr. Frank Barber, consulting bridge engineer, of Toronto, recently prepared plans and specifications for the reconstruction of six bridges, whose estimated cost is $15,715. The material used in construction will be concrete. A by-law covering the work will shortly be voted on by the ratepayers.

GUELPH.—The Board of Works have decided to pave a number of streets. Westrumite, vitrified brick and asphalt will be used.

HASTINGS.—The first work on this section of the Trent Valley Canal has begun and the river front for some distance up will be completely changed by a concrete and steel pier.

TORONTO.—City Engineer Rust has recommended for construction pavements which will cost $141,855.

**Manitoba.**

BRANDON.—City Engineer Speakman recently submitted to the council an estimate of the cost of street improvements totalling $30,000.

WINNIPEG.—Notice has been given of the city's intention to make certain local improvements, including pavements, walks and sewers.

WINNIPEG.—Plans are in course of preparation for new superstructure for the Louise bridge and for the Main Street bridge. The estimated cost of an overhead bridge exceeds two hundred thousand.

WINNIPEG.—Two big contracts have been started by Haney, Quinlan and Robertson, contractors for the National Transcontinental Railway. Work on the fundations of the new Lombard Street bridge is under way and a gang of 125 men has started on the work of driving the thirty-five-foot steel concrete piles. Preparations are being made also for laying the foundations of the locomotive shops on the Transcontinental site at Springfield.

**Saskatchewan.**

REGINA.—The number of permits issued for building in Regina during June amount to 34, and are valued at $121,650. Total to date, 153 permits issued, value $362,645. Permits issued during June, 1908, 30; value, $75,310. Total to 30th June, 1908, 142 permits, value, $156,183.

**British Columbia.**

VANCOUVER.—The corporation of Oak Bay received tenders until July 15th for the construction of numerous sidewalks and sewers.

**Foreign.**

BOSTON, MASS.—The Aberthaw Construction Company report the completion of the eight-storey Baxter Building at Portland, Maine, and the Goodell-Pratt Company's foundry at Greenfield, Mass. Work is well under way on the reinforced concrete factory building for the Carter Ink Company, at East Cambridge, Mass. The Aberthaw Company are also building some reinforced concrete floors for the Mittineague Paper Company, Mittineague, Mass.

## CURRENT NEWS.

**New Brunswick.**

ST. JOHN.—The transfer of the Rhodes, Curry business at Amherst is announced. The owners now are C. Meredith & Company, Limited, and the Royal Securities Corporation, Montreal, and J. M. Robinson & Sons, and W. B. Tennant of this city, and J. R. Douglas, of Amherst.

**Ontario.**

OTTAWA.—Work is progressing satisfactorily on the Trent Canal, which will be finished in about four years. Data and information are being collected with reference to the projected deepening of the Welland Canal or the construction of a new canal adjacent to it.

OTTAWA.—The Government is not expecting to receive much before September 1st, the report of the Quebec Bridge Commission and the outside engineers called in consultation with it. It is stated that building operations will not be begun before spring, though the contract will be let late this fall.

TORONTO.—It is reported that two of the contractors who tendered and were awarded contracts for the construction of portions of the waggon roadway from Elk Lake to Gow Ganda, have abandoned their contracts and will lose the checks deposited with the Government for the completion of their work. No official statement has yet been made concerning the matter, but it is believed that the chief difficulties were lack of transportation facilities and inability to secure and hold labor. The route is believed to be an exceptionally good one for the country, but the contractors, necessarily encountered many obstacles by reason of its primitive character. It is understood the Government will call for new tenders at once.

TORONTO.—Manager J. O. Orr, of the Canadian National Exhibition has received a letter from the chairman of the universities engineering trip from London, to the effect that the party will be in Toronto during the Exhibition. They will be entertained at the Fair. The civil engineers, ten in number, representing the English universities, will visit several large manufacturing establishments.

**Saskatchewan.**

SASKATOON.—Messrs. Brown & Vallance, of Montreal, have been asked to prepare plans for the University of Saskatchewan buildings, which will accommodate 5,000 students.

**British Columbia.**

VANCOUVER.—Preliminary plans for a high level bridge over False Creek at Cambie Street, estimated by Engineer J. L. Harrington to cost about $750,000, have been approved by the Bridge Committee of the City Council. A by-law will shortly be submitted to the ratepayers.

## PERSONAL.

MR. LOUIS COSTE, of the Department of Public Works, visited St. John, N.B., recently for the purpose, it is understood, of furthering the scheme for a drydock.

JAMES SMEATON has been engaged as inspector of concrete work at the Point du Bois (Winnipeg) power plant, by Smith, Kerry & Chace, the engineers in charge.

MR. F. P. GLOVER, assistant manager of the B. C. Electric Railway, Mr. T. Blundell-Brown, a London director, and Mr. Mitchell-Innes, who is connected with the board of management, recently made a thorough inspection of the road.

MR. ALBERT H. E. WILKES, formerly assistant storage battery engineer with The Chloride Electrical Storage Co., Limited, of Manchester and London, England, has joined the staff of the Canadian General Electric Co., Limited, Toronto. He will take charge of their storage battery department.

MR. HARRY G. NICHOLLS, for many years assistant general manager of the Canadian General Electric Co., has

(Continued on Page 42.)

## MARKET CONDITIONS.

Toronto, July 15th, 1909.

Business in metals is quiet. There is no very disturbing news from abroad, and prices both there and here are steady. Hardware merchants are talking already about the mid-summer holiday dullness, which appears to have come prematurely on. We can hear of no alteration in prices. Hot weather goods and sporting goods are the only ones that can be said to be moving actively.

Bricks, lumber, lime, and other building materials are moving freely in Toronto, where the erection of dwellings goes on as if there were soon to be no old ones left tenanted. Cement is, however, an exception to the general activity, for there is but a limited movement and prices have reached a very low point.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. The spring rush is over and business steady.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, which is an indication of the state of the wholesale market, a price heretofore unheard of. The over-supply continues. Smaller dealers report a fair movement in small lots at $1.40 to $1.50 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.50, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—Unchanged and quiet at $13.85 to $14.05 per 100 lbs. Demand abroad not commensurate with real values at present prices.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $2.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is rather weaker, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—Considerable demand for both Southern and Canadian dimension pine continues; hemlock dull. Prices are rather stiff all along the line. Dressing pine quotes $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar quotes $3.50 per barrel.


# SHEETS!

Aluminum Lead
Brass Tinned
Copper Zinc

At lowest prices for prompt deliveries.

**A. C. LESLIE & Co., Limited**
**MONTREAL.** 7


**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—In moderate request at prices per catalogue. It is impracticable to quote figures, so great is the variety of this kind of goods, but prices are steady.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 4 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Not much moving; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—Prices steady and demand good. The price continues at 31c. to 31½c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

* * * *

Montreal, July 14th, 1909.

In certain sections of the United States, pig-iron has advanced slightly in price. A message from Chicago, dated Monday, announces that prices have been advanced 50c. per ton, putting northern grade on a basis of $17, and No. 2 foundry and southern at $12.50. Both from Chicago and other portions of the country come predictions of further advances in the near future. The most hopeful sign of the times is the increased demand from railways, for rails and cars and other supplies of like nature. This is bound to shortly be felt right along the line, and, if continued, as is at present the promise, there is every likelihood of something in the nature of a boom taking place in the iron industry. The recent troubles and uncertainty, as respects the iron and steel duties in the United States, will soon have passed away and the promise of a good crop and remunerative employment to the rolling stock will have a good effect upon the trade of the entire country.

In Great Britain, the sound of woe still arises, but there is evidence that the people, having glutted themselves with pessimism, will shortly turn to and get busy at their industrial pursuits, once more. Meantime, there is but little export demand for iron, and the home demand is not sufficient to cause the business to look prosperous.

Canada continues in good shape. The outlook for the fall trade is excellent. Practically all the reports from the wheat fields of the West are such as are welcomed and, although the crop has still a few critical stages to go through, every day improves the chances in its favor. A large crop will go a very considerable distance towards restoring trade in iron and steel. The strike is still on in Glace Bay, but there are evidences of growing strength on the part of the company. Prices in the following list are holding fairly steady:—

**Antimony.**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3 1-2-inch, 14½c.; 4-inch, 19c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b.,

# The Canadian Engineer

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## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. JAMES, B.A. Sc.
**Business Manager**—JAMES J. SALMOND

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TORONTO, CANADA, JULY 23, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## THE RAILWAY AND THE STATE.

"If the State cannot control the railways, the railways will control the State," was an Englishman's way of expressing the relation of the railway and the State.

Railways are for public service, and it is right that they should be operated in the public interests, but it is yet to be proven that public ownership of railways, which in theory is good, is for the general good. Public servants have allowed public works and public franchises to be run, not in the interest of the country at large, but in the interest of those sections or communities which could bring the greatest pressure to bear.

The history of the railway situation in various lands is not without lessons.

In Australia all the railways are State-owned, built by the different State Governments. In some instances they were not a success under State control, but when placed under a commission they became successful financial ventures, and public sentiment is so strong for public-owned roads that it is not likely that there will be any serious development of private lines.

Belgian railways were State-built because the nation feared foreign capital would control the transportation highways.

Switzerland nationalized her railways in a fit of patriotism, French and German capital having controlled the Swiss railways for years.

Italy, after the union of 1870, acquired the railways and leased them to three companies to operate. But the trouble over capital for new lines, extensions and betterments became so acute that they were compelled to cancel the lease, and now Italy has Government-operated lines.

Holland bought up the private railways, unified the systems, and then leased them to two companies, whose lines have access to all the principal towns and ports.

Each country appears to have developed a system to suit its own particular fancy, but the history of railway operation does not appear to point to any great tendency towards absolute State ownership and State control.

## DANGEROUS STRUCTURES.

In many municipalities the city engineer and his department are responsible for building permits, and for this reason we feel that a discussion of the matter is justified in these columns.

There are two classes of persons to be considered—the occupants of the building and those who, while not occupants, are within the danger zone. Both must be protected. In some cases those in the first class feel they are being protected against themselves. This is necessary.

It is not intended that this article should deal with safe design of new buildings, but rather to call attention to some of the danger points of completed and long-standing buildings that should be examined.

Street signs are a frequent source of danger, and their size and condition should be more carefully regulated than is the case in many municipalities. If overhanging street signs were prohibited, no great hardship would result. There are so many safer and saner methods of advertising than hanging out signs of crude

design that shut off the view and make the street line unsightly.

In the same class may be placed the overhanging balconies. Frequently, they are built of wood, and when they become old are dangerous to those who occupy them and to those who pass under. Their position—commanding a good view of the street line—results in their being frequently loaded to the danger point.

Now that our banks, trust and land companies, and even our large stores are using overhanging cornices and coping stones as a means of exterior decoration they should be carefully inspected. The action of rain and frost tends to chip off sections, and even to move the large blocks from their setting.

## UNION OF CANADIAN MUNICIPALITIES.

The Union of Canadian Municipalities will hold their annual meeting this year at Medicine Hat, Alta., on July 26th, 27th and 28th.

The first day will be taken up with addresses of welcome and replies, and reports from officers and committees.

The second and third days will be devoted to discussions on Public Utility Commissions, Western Municipal Development, the Juvenile Delinquents' Act, Methods of Street Widening, and Water Filtration and Sewage Disposal Works.

## THE PRESERVATION OF IRON AND STEEL.

Associations have been organized, having for their object the preservation of our forests and water powers, and in our zeal for the "preservation of natural resources" we have neglected certain other material just as valuable, just as much used, and subject to as great a monetary loss.

It is a wonder more attention has not been given to the preservation of iron and steel. The annual production of pig-iron alone amounts to, in America, almost 250 million dollars, and the finished steel to many times this.

Such a vast outlay as is annually made for iron and steel should encourage study of methods of protection.

The corrosion of iron may be prevented by the manufacture of a metal which has a high resistance to corrosion; by applying protective coatings, which may be other metals, paints and oil, or bituminous materials, or by specially preparing and treating the surface.

The question is worthy of more study than it has been given.

## MR. LUMSDEN RETIRES.

Six years of work and worry, of exacting, hard work, and at times of thankless service, have led to the retirement of Mr. H. D. Lumsden, Chief Engineer of the eastern division of the National Transcontinental Railway.

Mr. Lumsden was a railway engineer of long and varied experience, having been one of the staff of engineers, who, under Sir Sanford Fleming, located the C.P.R. through the Yellow Head Pass some thirty years ago. Since then he has had to do with most of the important railway surveys of this country.

Mr. Gordon Grant, Mr. Lumsden's successor, is a member of the Canadian Society of Civil Engineers, and has had a long experience on railway work.

For the past few years he has been Inspecting Engineer for the Transcontinental Commission, and no man is in closer touch with the work on the grade, nor understands the condition of the various sections better than Mr. Grant.

His is a great honor, but the responsibility is also great. To take up an uncompleted task, to assume responsibility for work under way, and to avoid becoming the theme of parliamentary discussion will require great tact and tireless effort.

## EDITORIAL NOTES.

The railways have submitted a new freight tariff on coal to non-competitive points in Western Canada. This new schedule was prepared in response to the demands of the Associated Boards of Trade, but it is unsatisfactory, and opposition will be offered when the tariff is up for sanction before the Railway Board.

* * * *

The Canadian Civil Service Commissioners are now in charge of examinations and the appointments to certain Government positions. It remains to be seen whether difficult examinations and small pay will build up a more efficient civil service than the old method.

* * * *

A thoughtful critic, of long commercial experience in New York city, says: "The stock market has lately lost much of its reputation as a barometer. Formerly, it was the expression of thousands of the most bright and alert minds and their profoundest judgment as to coming events; lately it has been the expression of the opinions and desires of a few financial cliques and the brute financial force that they are able to exert, backed by a mob of followers more intent on their leaders' operations and the next move to be made by them than on the actual conditions, present or prospective."

**Our supply of copies of the Canadian Engineer ofr March 19th, 1909, is exhausted. We will extend one month the subscription of any reader forwarding a copy to our Toronto office.**

## EXHIBITORS AT WINNIPEG EXHIBITION.

The Brydges Engineering and Supply Company, had a most interesting display of internal combustion engines at the Winnipeg Industrial Exhibition last week. The plants on exhibition were a 6½ horse-power gasoline engine driving a patent high-speed pump, and a 6½ B. horse-power suction gas plant and engine, driving a Westinghouse dynamo. The suction plant is the smallest ever exhibited in America, and is creating general interest. It represents the latest development in English gas engine practice, and demonstrates the practical utility of this form of power even in the smallest sizes. The noticeable feature of this type of plant is the complete absence of smoke, everything combustible in the coal being turned into gas. Water troubles such as are found in steam boilers, are entirely eliminated. Producer gas is made by passing steam and air through a bed of incandescent fuel. In the suction plant all this is done by the engine itself, and the quantity of gas made is automatically regulated according to the varying load which is put on the engine. The outfit requires little attention, it being necessary to coal only once in three or four hours, and this operation is very simple, and only takes two or three minutes' time. As an evidence of the economical working of gas plants, it may be stated that the one on exhibition when running at full load, uses less than 6 lbs. of coal per hour. Under certain conditions the gas plant and engine is undoubtedly the cheapest form of power that can possibly be obtained. The excellent finish and massive design of the engines is a matter of general comment amongst the spectators.

(Continued on Page 87.)

# GRAPHIC SOLUTION OF KUTTER'S FROMULA.

By L. I. Hewes and Joseph W. Roe.*

A graphic solution of Kutter's formula for the flow of water has been worked out by Dr. L. I. Hewes in connection with his course in graphic computations, given in the Sheffield Scientific School, Yale University, which may be of interest to those who deal with canals, flumes and streams.

Kutter's formula, $$V=\left[\frac{41.66+\frac{1.811}{n}+\frac{0.00281}{S}}{1+\left(41.76+\frac{0.00281}{S}\right)\frac{n}{\sqrt{R}}}\right]\sqrt{RS}$$

the nature and condition of the bottom. Usually, R and S have been determined; n, assumed, and it is desired to calculate V. In this case the diagram is read as follows: From the given value of R on the middle scale project horizontally to the curve of the n-value assumed; thence project vertically to the diagonal. A straight-edge through the point on the diagonal so found and the point on the S-scale determined by the given conditions will cut the V-scale at the required mean velocity. The chart furnishes a means of determining any one of the four factors, the other three being known. This would be especially useful where it is desired to find a coefficient, n, corresponding to a given set of conditions, as the solution of Kutter's formula for this factor is especially troublesome.

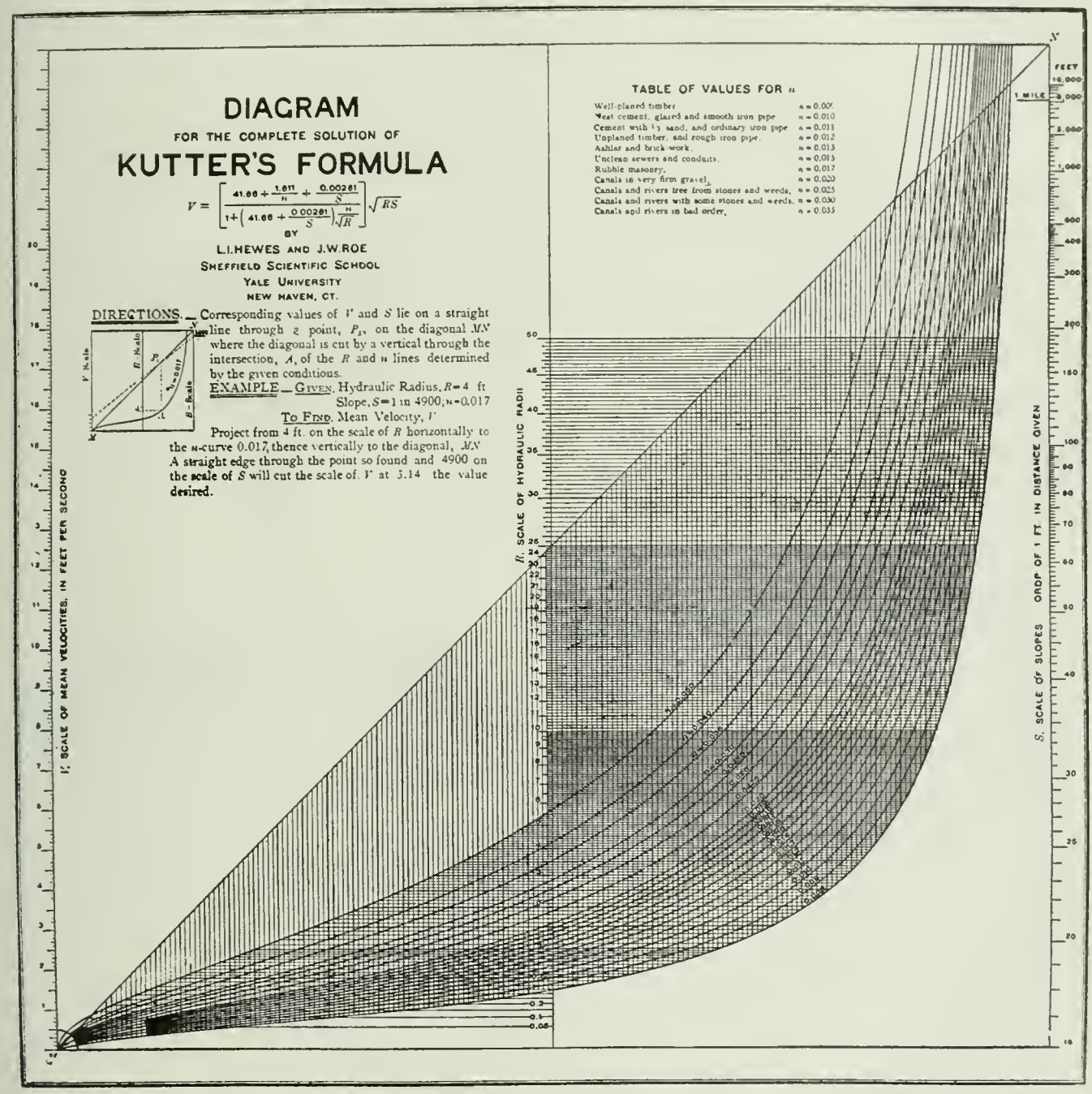


DIAGRAM
FOR THE COMPLETE SOLUTION OF
KUTTER'S FORMULA
$V=\left[\frac{41.66+\frac{1.811}{n}+\frac{0.00281}{S}}{1+\left(41.66+\frac{0.00281}{S}\right)\frac{n}{\sqrt{R}}}\right]\sqrt{RS}$
BY
L.I.HEWES AND J.W.ROE
SHEFFIELD SCIENTIFIC SCHOOL
YALE UNIVERSITY
NEW HAVEN, CT.
DIRECTIONS.—Corresponding values of V and S lie on a straight line through a point, $P_1$, on the diagonal MN where the diagonal is cut by a vertical through the intersection, A, of the R and n lines determined by the given conditions.
EXAMPLE—GIVEN, Hydraulic Radius, R=4 ft
Slope, S=1 in 4900; n=0.017
TO FIND, Mean Velocity, V
Project from 4 ft. on the scale of R horizontally to the n-curve 0.017, thence vertically to the diagonal, MN. A straight edge through the point so found and 4900 on the scale of S will cut the scale of V at 5.14 the value desired.
TABLE OF VALUES FOR n
Well-planed timber, n = 0.009
Neat cement, glazed and smooth iron pipe, n = 0.010
Cement with ½ sand, and ordinary iron pipe, n = 0.011
Unplaned timber, and rough iron pipe, n = 0.012
Ashlar and brick work, n = 0.013
Unclean sewers and conduits, n = 0.015
Rubble masonry, n = 0.017
Canals in very firm gravel, n = 0.020
Canals and rivers free from stones and weeds, n = 0.025
Canals and rivers with some stones and weeds, n = 0.030
Canals and rivers in bad order, n = 0.035
V. SCALE OF MEAN VELOCITIES, IN FEET PER SECOND
R. SCALE OF HYDRAULIC RADII
S. SCALE OF SLOPES DROP OF 1 FT. IN DISTANCE GIVEN
FEET
1 MILE

is probably the most accurate of those proposed determining the flow of water. But it is extremely cumbersome, and if many calculations are to be made their solution becomes drudgery. The purpose of this chart, Fig. 1, is to furnish a rapid solution, sufficiently accurate to be well within the limits of the observed data.

The chart consists essentially of three parallel scales, one for the mean velocity, V, one for the hydraulic radius, R, and one for the slope; a diagonal line, not graduated; and set of curves for the various values of n, the factor which involves

The range of values covers all but the most extraordinary conditions. The graduations on the V-scale range from 0 to 25, far beyond any velocity encountered in practice; the scale of hydraulic radii ranges from 0 to 50 ft.; the slopes range from 1 in 16 to 1 in two miles; and the n-curves cover all the values given in any of the books of reference.

The accuracy of the chart is about uniform for the various conditions encountered. Where the n-curves are acute to the R-scale, the scale itself is very coarse, thus compensating for any error due to the obliquity of the curves. Opposite the upper end of the R-scale, where its graduations are finer, the n-curves have turned and are nearly parallel to it, so that an error

*Paper read before New Haven meeting Am. Inst. M. E.

in reading the R-scale has but little effect on the location of the pivot-point on the diagonal. Each of the curves has been checked by calculations, and the mean error of the total readings was only 0.53 per cent. The V-scale, on which the results are usually sought, with reasonable care in reading, will give results correct to within two or three units in the third significant figure, an accuracy well within that of the original data. The selection of n, for instance, is an element which introduces an uncertainty largely in excess of this.

Other graphic solutions of this formula have been worked out, but they nearly all involve a set of diagrams, one for each value of n. So far as we know, there have been none where the entire range of all factors has been included as conveniently in one diagram.

(Continued from Page 84.)

The Brydges Engineering & Supply Company, are agents for Wm. Jacks & Company, of Glasgow, the contractors for the city at Winnipeg's high pressure station, and are prepared to design and fit similar installations in Western Canada.

The Stuart Machinery Company, had also a splendid exhibit of the lines of machinery which they handle. This company are Western agents for the McGregor Gourlay Co., of Galt; Georgian Bay Engineering Company, Midland, Ont.; Prescott Emery Wheel Company, Prescott, Ont.; Canadian Buffalo Forge Company, Montreal; the Maple Leaf Saw Works, Galt, Ont.; Frost Manufacturing Company, Galesburg, Ill.; Dodge Manufacturing Company, Toronto, Ont.; Canton Hughes Pump Company, Canton, Ohio; Beardmore Belting Co., Toronto, Electrical Construction Company, London; Stratford Mill Building Company.

The Stuart Machinery Company, not long ago had a bad fire, and their present accommodation is entirely too small, and it is the intention of the firm to erect in the near future a four-story building with all the modern conveniences for handling a large stock of machinery.

## RAIL FAILURES DUE TO BURNS AND CRYSTALLIZATION, CAUSED BY SLIPPING OF ENGINE DRIVERS, BALTIMORE AND OHIO RAILROAD.*

**By A. W. Thompson, Chief Engineer Maintenance of Way.**

One of the less frequent causes of rail failures, and one concerning which there is very little published information, is that weakness in a rail due to the burning and crystallization of the metal by slipping of engine drivers. Undoubtedly this is deserving of more attention than it has been given in the past, as there are numerous instances on record of wrecks and derailments caused by broken rails of this class. The breaks are distinguished from other kinds and show very characteristic structure of the fracture. They occur in localities where there is unquestionably much slipping of the drivers, such as at points where an engine starts a train in pulling out from a station, and also in freight service at points where there may be a regular stop and back-up movement, as at a junction.

Such rails also might be found in yards where heavy cuts of cars are handled by a single switching engine. A probable cause for the scarcity of the latter class is the lighter weight of the switching engines in comparison with the weight of the usual road engine. The recent rapid advance in the loads on driving wheels of switching engines, particularly in the larger and better equipped yards, may result in more failed rails from this cause, especially in that part of the yard in which the push and pull method of operation may be used.

In the text of papers written upon other subjects allied to the rail question, casual mention has been quite often made of specific instances of rail which has failed from crystallization of the metal, but these discussions and records have never been isolated or carried to any definite conclusion concerning this particular subject. There must be records of this kind in the files of every railroad, and interest should be taken toward making these available to the American Railway Engineering and Maintenance of Way Association, and compiling them into comparative and intelligible form.

To furnish a beginning upon which to build, the following instances, taken from the experience of the Baltimore & Ohio Railroad, are compiled in concise form, these being selected because test of the physical and chemical properties was made of the broken rail in question. The first instance which has come to the writer's notice occurred at Salisbury Junction; a westbound passenger train, running at a speed of 40 miles per hour, being derailed while passing around a 6° 30′ curve.

This curve is to the right, with a grade descending at the rate of 1.25 feet per 100, both in the direction of traffic. At the time of the accident the temperature was 10 degrees above zero.

The rail causing the accident was 33 ft. long, A. S. C. E. section, 85 pounds per yard, rolled by the Cambria Steel Company in 1905, and laid during August of the same year; thus showing a service of about two and one-half years.

**Failed Rail (Carnegie) Rolled 7-96. From Wreck at Shenandoah Junction.**

The rail was in the low side of the curve, being jointed with a four-hole splice, and it broke into twelve pieces. The lengths of the pieces varied from 3 in to 24 ft., most of which were over 1½ ft. long. The attached photographs show a view of these pieces with the exception of the end pieces, which remained in the splice. At two points the breaks were square, as if sawed, but in the other cases the breaks were slanting, each in different directions. This was the only rail damaged in the accident. Gauge at point of accident was found to be 4 ft. 8⅞ in.; elevation of curve, 6¼ in.; both line and surface were good.

Microscopical tests of the rail later developed the fact that slight cracks existed in the base of the rail before the accident occurred, but these cracks were entirely too small to have been detected by even close examination with the eye before the rail became separated. The rail was inspected by track walker only a short time before the derailment took place.

The rail showed very little wear and the only marks which could be detected were those made by the slipping of the drivers of the engine. The frequency with which these marks occurred on this one rail was due to the fact that westbound freight engines stop nearly always in about this spot to back

*From Bulletin No. 111 of the American Railway, Engineering and Maintenance of Way Association.

(Continued from Page 84.)

up and set off empties on the Salisbury Branch, and in considering the failure of this rail this point should be carefully borne in mind.

The pieces were not carried any distance, with the exception of the longer ones, and this condition would naturally lead to the conclusion that the breaks were caused by the downward pressure of the engine passing over the rail ends.

A chemical analysis of the rail showed the following:

| | Chemical Analysis. | Specifications Called for. |
|---|---|---|
| Carbon | .48 | .43 to .53 |
| Sulphur | .77 | ..... |
| Phosphorus | .108 | Not to exceed .10 |
| Manganese | 1.10 | .80 |

This analysis shows the composition to be rather high in phosphorus, with manganese closely approaching the upper allowable limit. While either one in itself would not be a serious matter, the combination would tend to make a somewhat brittle rail, even though the phosphorus is no higher than is found in many good rails.

In making physical tests of this rail a weight of tup of 1,640 pounds was used, this being the only drop available in the Test Bureau. Supports were placed 3 ft. apart, and when the test piece was placed in the machine with the head up the tup was allowed to fall 10 ft., and when the test piece was placed in the machine with the head down, the tup was allowed to fall 8 ft. It was the intention to so select the height of the drop that the number of blows would show a comparison of the different rails; that is, it was so arranged that the drop would not break a rail which had been in service and was not defective, while it might break a rail which was burnt. under these conditions the following results were secured. These conditions do not conform to those usually specified, but other rails were tested under same conditions in direct comparison:

Rail Causing Derailment at Salisbury Junction.

| | —Deflection in Inches— Head Up in Supports 10-ft. Drop. | Head Down in Supports 8-ft. Drop. |
|---|---|---|
| 1st Blow | .65 | broke |
| 2nd Blow | 1.20 | ..... |
| 3rd Blow | 1.80 | ..... |
| 4th Blow | 2.25 | ..... |
| 5th Blow | 2.75 | ..... |
| 6th Blow | broke | ..... |

The rail placed with head up broke with fine crystalline fracture, near supports. Rail with head down broke near center, on first blow, with a fine crystalline fracture.

Rail of Maryland Steel Company Tested for Comparison With Above.

| | —Deflection in Inches— Head Up in Supports 10-ft. Drop. | Head Down in Supports 8-ft. Drop. |
|---|---|---|
| 1st Blow | .61 | .62 |
| 2nd Blow | 1.30 | 1.06 |
| 3rd Blow | 1.80 | 1.44 |
| 4th Blow | 2.22 | broke |
| 5th Blow | 2.75 | ..... |
| 6th Blow | 3.25 | ..... |
| 7th Blow | broke | ..... |

This rail was perfect so far as known, but had seen service in track. With head up the test piece broke near support with a fine crystalline fracture. With head down it broke near the center with similar surface appearance.

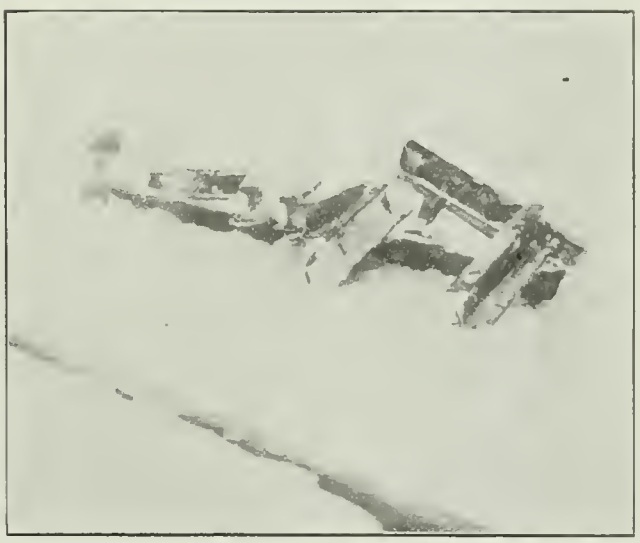
A further comparative test of rail of the Cambria Steel Company's manufacture showed the following:

| | Head Down in Supports 8-ft. Drop. |
|---|---|
| 1st Blow | .73 |
| 2nd Blow | 1.28 |
| 3rd Blow | 1.74 |
| 4th Blow | 2.22 |
| 5th Blow | 2.58 |
| 6th Blow | broke |

This rail also broke near center with fine crystalline fracture. A common and noticeable feature of all these breaks is that with head up they break near supports, while with head down they break near the center, but the burnt rail broke under a much less number of blows whichever way it was placed, and with a very much less final deflection.

The second instance in which any extended test was made of the chemical and physical properties of the failed rail occurred at Shenandoah Junction, as a westbound passenger train was pulling out from the station. This rail broke into five pieces and had been, evidently, badly burnt by slipping of the drivers as the engine started the train up a quite heavy grade from the station. The brittleness of this rail was further indicated by its breaking at one point while it was being cut at another by the section foreman.

This rail was rolled by the Carnegie Steel Company in 1896, of A. S. C. E. section, 85 pounds per yard. There was no surface indication of defect in the rail, and roadbed conditions were good and not contributary causes to this failure. Track was fully ballasted with stone and had good drainage, and the ties were in good condition and properly spaced. No undue strains were brought to bear on the rail by longer supports between ties or by any unusually flexible ballast.



**Views Showing Pieces of Rail which Broke at Salisbury Junction.**

The curve at this point was 4° 30′ and had an elevation of 3½ in., with gauge ¾-in. wide at the point of failure, caused by wear of rail over the standard gauge of 4 ft. 8½ in. on this degree of curvature. The grade was 0.75 per cent. ascending, westbound. The chemical analysis of this rail showed the following:

Rail Causing Derailment at Shenandoah Junction.

| | Chemical Analysis. | Specifications Called for. |
|---|---|---|
| Carbon | .48 | .43 to .53 |
| Sulphur | .027 | ..... |
| Phosphorus | .095 | Not to exceed .10 |
| Manganese | .76 | .80 |

The chemical composition of this rail is apparently good, but microscopical examination showed small cracks in the head, which may have been produced by slipping of the drivers, since these surfaces of the metal at the crack showed the characteristic blue color due to heating.

The drop test of this rail, made under the same conditions as those above, showed the following:

| | —Deflection in Inches— Head Up in Supports 10-ft. Drop. | Head Down in Supports 8-ft. Drop. |
|---|---|---|
| 1st Blow | .25 | broke |
| 2nd Blow | 1.00 | ..... |
| 3rd Blow | 2.50 | ..... |
| 4th Blow | 3.35 | ..... |
| 5th Blow | 4.10 | ..... |
| 6th Blow | broke | ..... |

Again in this test do we find the break near the supports when the head was placed up, and at the center when the head was placed down, each with a fine crystalline fracture.

In making the above test with the head up, a piece one foot long was snapped off of the end of the test piece where it projected over the supports, the fracture of which showed about 60 per cent. of an old defect in the head and 40 per cent. in the web. The attached photograph of this section shows plainly the burnt and crystallized condition of the metal and the different color of the injured portion. It also discloses a small pipe near the base of the rail.

After the piece with head down had been tested, a further test was made of a piece of this same rail 10 in. in length, which was broken off with a sledge-hammer, and clearly showed a burnt spot in the head ¾-in. long by 5/16-in. deep.

A summary of these tests in tabular form follows:

| | Standard Rail after Service. | | | | Rail Causing Shenandoah Jct. Wreck. | | Rail Causing Salisbury Wreck | |
|---|---|---|---|---|---|---|---|---|
| Manufacturer.... | Maryland Steel Company | | Cambria Steel Company | | Carnegie Steel Company | | Cambria Steel Company | |
| Date rolled ..... | July, 1905. | | April, 1907. | | July, 1896. | | March, 1905. | |
| | No. of Blows | Fracture | No. of Blows | Fracture. | No. of Blows | Fracture. | No. of Blows | Fracture. |
| Drop 10 ft. Head up..... | 7 | Fine Crystalline near Support. | | | 6 | See Photograph. | 6 | Fine Crystalline near Support. |
| Drop 8 ft. Head down ..... | 4 | Fine Crystalline at Centre. | 6 | Fine Crystalline near Centre. | 1 | Near Centre burnt spot. | 1 | Fine Crystalline near Centre. |

An examination of this table, keeping in mind the chemical analysis, indicates clearly the weakening effect due to the burn.

All these failures correspond in location and when the test pieces were turned with head down one blow broke such rails as were burned, whereas rails which had seen service in track, but were not defective, required four to six blows to cause a break. The burnt rail of the Carnegie Steel Company being of fair chemical composition, shows conclusively that failure was due to burns. There is a possibility that in the case of the Cambria Steel Company's rail the chemical composition had something to do with the failure, as the rail only showed a service in track of 2½ years. While both of these rails were marked with burns due to slipping, and in all probability failed from that cause, yet the term of service was so different, as well as other conditions, that no definite conclusions should be drawn from these two instances alone.

Such a failure as that at Salisbury Junction might have been the sooner induced because of the greater vibration and impact from the momentum of the passenger engines, with their higher speed, together with the blow from the reciprocating parts and the wheel balance, and in those tests made with the heads down, this very metal which has been burnt and weakened by crystallization is subjected to the greatest tensile stress. With the head up the same metal is on the compression side of the neutral axis, and under such conditions naturally would not fail as quickly, this being borne out by the records of the tests.

These rails were called upon to withstand heavy traffic, both freight and passenger, on curves and grades somewhat above the average, but these records are not complete or conclusive, and are interesting only as being specialized on failures due to a change in strength of metal from burning. Further records are needed, not alone to determine the effect upon the rail itself, but to tabulate the loss and damage in wreck from this particular cause, that the importance of this subject may be brought clearly to the attention of the officers of all roads, to the end that steps may be taken to prevent such practice in so far as it is possible.

(Continued from Page 89.)

and a ten-inch board firmly nailed to the bottom of the posts to prevent snow from blowing off the elevated roadway, be constructed on each side of every approach to a rural railway crossing where the height is six feet or more above the level of the adjacent ground, leaving always a clear road-surface twenty feet wide.

3. That the width of approaches to rural railway crossings made in cuttings be not less than twenty feet clear from bank to bank.

4. That, unless otherwise ordered by the Board, the planking or paving blocks, or broken stone topped with crushed rock screenings, on rural railway crossings over highways (between the rails and for a width of at least eight inches on the outer sides thereof) be **twenty feet** long on concession and main roads, and **sixteen feet** on side and bush roads.

10. Leave may be reserved to each of the railway companies affected by this order to move to extend the time for compliance therewith.

**RENEW YOUR SUBSCRIPTION NOW**

**And get the Benefit of the Two Dollar rate. After August 1st 1909 all renewals will be at the rate of Three Dollars. You may renew now for any number of years at the old price.**

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of July 14 | |
|---|---|---|---|---|---|
| | | | | 1909 | 1908 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,621,000 | 1,497,000 |
| Canadian Northern Railway | 2,986.9 | | | 191,300 | 177,500 |
| Grand Trunk Railway | 3,536 | 226,000 | 100 | 789,746 | 749,015 |
| T. & N. O. | 334 | (Gov. Road) | | 80,190 | 17,544 |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 77,196 | 70,225 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,242 | 65,913 |
| Winnipeg Electric | 70 | 6,000 | 100 | | |

STOCK QUOTATIONS

| | TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|
| | Price July 16 '08 | Price July 8 '09 | Price July 15 '09 | Sales Week End'd July15 | Price July 16 '08 | Price July 15 09 | Price July 15 '09 | Sales Week End'd July15 |
| Canadian Pacific Railway | 168 167¾ | 183 | 186 184½ | 235 | 167½ 167¼ | 183⅜ 182½ | 185 184½ | 2685 |
| Canadian Northern Railway | | | | | | | | |
| Grand Trunk Railway | | *1st. pref.105½, 3rd pref. 56¾, ordinary 23¾ | | | | | | |
| T. & N. O. | | | | | | | | |
| Montreal Street Railway | | | | | 174 172½ | 218 217 | 216 215½ | 285 |
| Toronto Street Railway | 98¾ | 124½ | 125 | 24 | 97½ 97 | 124 123¾ | 124 123¾ | 387 |
| Winnipeg Electric | 158 | 186 185½ | 187½ | 85 | | 185½ | | 25 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILWAY EARNINGS.

United States railroads for the first week of July show total gross earnings of $6,536,143, an increase of 6.3 per cent. over last year and a loss of only 0.8 per cent. compared with the corresponding period in 1907. In the following table are given earnings of United States roads reporting for the first week of July and the same roads for a like period in June; also the more complete reports for June and the two preceding months:

Gross Earnings.

| | 1909. | Gain. | Per Cent. |
|---|---|---|---|
| July, one week | $ 6,536,143 | $ 386,644 | 6.3 |
| June, one week | 6,527,303 | 657,716 | 8.0 |
| June | 37,769,725 | 3,251,844 | 9.4 |
| May | 43,097,449 | 5,367,794 | 14.2 |
| April | 42,473,864 | 4,786,961 | 12.7 |

The preliminary report for June of all United States roads included shows total gross earnings of $37,769,725, a gain of 9.4 per cent. Compared with June, 1907, there is a loss of 8.8 per cent. Railroads continue to make a better showing each month, compared with 1907. In the comparison with 1908 there is a considerable increase on the Pacific systems; also on the Southwestern roads. The Western Trunk lines show a gain of 4.2 per cent. and the Central Western a gain of 3.6 per cent. Southern roads report an increase of 7.5 per cent. The statement is printed below:

| | 1909. Gross Earnings. | Gain. | Per Cent. |
|---|---|---|---|
| Trunk West | $ 5,805,628 | $237,303 | 4.2 |
| Central West | 6,166,643 | 214,618 | 3.6 |
| Southern | 12,200,568 | 855,982 | 7.5 |
| Southwestern | 8,959,133 | 963,370 | 12.0 |
| Pacific | 4,637,753 | 980,570 | 26.8 |
| U. S. roads | $37,769,725 | $3,251,844 | 9.4 |
| Canadian | 6,354,000 | 896,000 | 16.4 |
| Mexican | 4,795,561 | 236,109 | 5.1 |
| Total | $48,919,286 | $4,383,953 | 9.8 |

## SOO EARNINGS.

The following figures relate to the "Soo" Railway for the eleven months ended May 31st:—

| | 1909. | 1908. |
|---|---|---|
| Gross Earnings | $11,536,678 | $10,589,104 |
| Operating Expense | 6,503,100 | 6,572,275 |
| Net Earnings | 5,033,571 | 4,016,889 |

## FENCING OF RAILWAYS.

An order of the Board of Railway Commissioners for Canada, dated May 4th, 1909, orders that all railway companies subject to the jurisdiction of this Board, shall, as to all railway lines completed, owned, or operated by them, where the lands on either side of the railway are not enclosed, settled, or improved:—

1. On or before January 1st, 1911, erect and maintain, on each side of the right of way (1) fences of a minimum height of four feet six inches, with swing gates, at farm crossings, with minimum height aforesaid, with proper hinges or fastenings; (2) cattle guards on each side of the highway at every highway crossing, at rail level: Provided that sliding or hurdle gates, constructed before the 1st day of February, 1904, may be maintained.

2. The railway fences at every highway crossing shall be turned into the respective cattle guards on each side of the highway.

3. All fences, gates, and cattle guards shall be suitable and sufficient to prevent cattle and other animals from getting on the railway.

4. As to lines not yet completed or opened for traffic, or in course of construction, all such companies shall—

(1) Erect fences, gates, and cattle guards as aforesaid as the rails are laid.

(2) If not yet opened for traffic, then such fences, gates and cattle guards as aforesaid shall be erected and maintained before such railway shall be opened for traffic.

(3) Where the railway is being constructed through enclosed lands, it shall be the duty of the railway company to at once construct such fences or take such other steps that will prevent cattle and other animals escaping from such enclosed lands.

5. As to all railway lines completed, owned, or operated, where the lands on either side of the railway are enclosed, settled or improved, such company shall erect and maintain such fences, gates and cattle guards, and in all respects comply with Section 254 of the Railway Act, on or before the 15th day of October, 1909.

6. Where it shall be made to appear to the Board that no necessity exists for the fencing or other works hereinbefore directed, the company or companies may apply to the Board for exemption from fencing, and other works, and such exemptions may be made as the Board deems proper.

7. All railways now in operation shall, within the time aforesaid, construct and maintain suitable and proper highway crossings, except such as may have already been covered by previous orders apportioning cost or providing for liability for maintenance, at all such as are being used for travel, and additional ones at once upon such highways being from time to time opened and used for travel.

8. All railways not yet opened for traffic, or hereafter constructed, shall, before the same are opened for traffic, construct and maintain suitable and proper highway crossings at all such as are being used for travel, and additional ones at once upon such highways being from time to time opened and used for travel.

9. All such crossings shall comply with the standard conditions of the Board, in so far as the same may be applicable, which are as follows:—

1. That, unless otherwise ordered by the Board, the width of approaches to rural railway crossings over highways be twenty feet road surface on concession and main roads and sixteen feet on side and bush roads.

2. That a strong, substantial fence or railing, four feet six inches high, with a good post-cap (four inches by four inches), a middle piece of timber (1¼ inches by 6 inches),

(Continued on Page 88.)

THE
# Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## LINDSAY'S WATER SUPPLY AND OZONE PURIFICATION.

The town council of Lindsay, Ont., have taken over the ozone plant recently installed by a company, and have accepted the plant as efficient and generally in accordance with the specified undertakings.

The plant has not yet received the approval of the Ontario Provincial Board of Health; in fact, has not yet been examined by that authority. The minutes of the Board of the last meeting instruct the chairman, Dr. Sheard, along with Dr. Hodgetts, to visit the plant, and report what measures should be taken as to amount of time required, etc., in order to make a proper report and analyses of the water, so that the Board may determine upon the efficiency or otherwise of this plant, which is new to Canada. This minute is not yet carried out.

Ozone treatment is not a new thing as applied to water purification processes. It is new to Canada. If ozone treatment can be made to work efficiently and economically in Canada, it must be welcomed, as its very compactness makes it easily protected from frost as against the difficulty of protecting large, slow, sand filtration areas.

Town engineers, health officers and sanitarians generally look to the Provincial Board of Health to give some definite pronouncement on the Lindsay plant, such a pronouncement to be based upon accurate data.

The Sanitary Review of April 9th last contained an article dealing with this subject, and it was there stated that it was understood that the works were being installed subject to the approval of the Provincial Board, represented by their bacteriologist, who, of course, is the officer capable of forming an exact opinion, based on the requisite data of analyses.

Why the town council have relieved the contractors of this responsibility without this approval we are at an entire loss to know.

A private report and analysis tests have been obtained apart from the Board of Health. These we publish in this issue. The town council evidently are content, and do not think it necessary to await the authoritative decision of the Ontario Health Central Authority.

We have given some attention to the report and analyses made, and, although interesting, we must confess that we cannot enthuse over the results to the extent either of the town council or the local papers. As far as the town of Lindsay is concerned, we cannot yet accept its ozone treatment as satisfactory.

Let us briefly examine this report and analyses tests made by Dr. Archibald, of Toronto University.

The doctor, in the letter accompanying the report, states that the plant is entirely satisfactory, and then goes on to say that the electric current is not sufficient, in his opinion, and recommends that the current should be increased and the pressure made constant.

We must be excused from attempting to blend these two statements: the one which says the plant is efficient; the other, which says it is not.

The report states, further: "It is rather unfortunate that, at the time these tests were made, the raw river water should have been so pure, from a bacteriological standpoint, as it is hardly a fair criterion from which to judge of the efficiency of the plant." This can only mean that the bacterial count was so small that it was beneath the pride of the ozone to stoop to conquer. One would, however, have almost expected that with such a powerful sterilizing agent as ozone is said to be that the few bacteria in the raw water would have been immediately blasted out of existence. Such, however, is not the case; in fact, the percentage removal falls far short of what is even guaranteed by ordinary mechanical filters, to say nothing of the more perfect process of slow sand filtration.

The analyses show the numbers of bacteria in the raw water, the number in the filtered water, and the number in the ozone sterilized water. This plant consists of a combined system of, first, filtration, and second, ozonization. The percentage removals of bacteria due to each process are of interest, and we have worked them out. No account is taken of test No. 5, which shows an enormous increase in bacteria after ozonization. Test No. 9 is also ignored, as there is apparently no bacteria in the raw water per c.c. This leaves us altogether nine tests from which to deduct averages of percentage removals.

| | Per cent. |
|---|---|
| Removal of bacteria due to filtration..... | 67 |
| Removal of bacteria due to ozone..... | 59 |
| Total percentage removal of bacteria due to combined processes ..... | 89 |

From the above it will be at once seen that filtration has proved a more efficient means of bacteria removal than ozone. Further, that the total removal is far below the percentage required either from mechanical or slow sand filtration.

The ordinary guarantee required by the United States Board of Health for mechanical filters is as follows: "That the filtered water shall be bright and clear, and free from suspended matter visible to the naked eye; that there shall be an average bacterial reduction of 97 per cent." With slow sand filtration it is a poor efficiency removal when the removal is under 99 per cent.

With sterilization we must look for better results than are even obtained by either mechanical or slow sand filtration. Slow sand filtration, if properly worked, is nearly perfect. Only absolute sterilization can beat it. Lindsay has not yet succeeded, according to the reported analyses, of by any means reaching either the efficiencies expected by mechanical or slow sand filtration, nor has it approached sterilization.

On the question of the efficiency of the Lindsay plant we are content to keep an open mind for the present. We desire its complete and entire success. We look to Dr. Sheard, the chairman of the Provincial Board of Health, assisted by his able lieutenants, to make such an examination and present such a report upon the efficiency of this plant, which is on its trial in Canada, that we may be able to form some definite conclusion on the matter.

## LINDSAY FILTRATION PLANT.

Several months ago the town to Lindsay, Ont., made a contract with Mr. J. Howard Bridge for an ozonization plant. The building and apparatus have been completed, and Dr. T. D. Archibald, of Toronto, made tests, and upon his report the municipality accepted the plant.

Dr. Archibald's letter of transmission is given with his report, as they must be read together before one can obtain a true idea of the conditions attending the test and the value of the conclusions arrived at.

University of Toronto,
Pathological Department,
Toronto, Canada, July 11th, 1909.

My dear Mr. Ray,—

I enclose the following report which seems to prove, as you will see by the figures, that the plant is entirely satisfactory under ordinary conditions. Should there be anything which you do not understand, or any point on which you wish further information, I would be very pleased to have you let me know as soon as possible, when I will endeavor to give you further light on the matter.

Although outside of the scope of my examination, I should think that attention should be paid to the electric current which is available for the running of the pump and the ozonizing of the water, that is to say that sufficient electricity should be furnished and the amount of current and pressure should be constant. However, that question is one with which an engineer should deal.

I handed over the specimen of water which you gave me to the Board of Health.

Yours truly,

T. D. Archibald.

July 10th, 1909.

The Board of Water Commissioners, Lindsay, Ontario.

Sirs.—I beg to submit the following report on the analysis made by me as to the efficiency of the plant installed in your town by Mr. J. Howard Bridge for removing bacteria from the raw water supplied by the river.

In all, eleven tests were made under varying conditions, and the results of these are seen in the attached table. The conditions under which the water was obtained and any extraordinary circumstances that arose during the tests are likewise noted. It is rather unfortunate that, at the time these tests were made the raw river water should have been so pure from a bacteriological standpoint as it is hardly a fair criterion from which to judge of the efficiency of the plant. There is one instance, however, test No. 10 which seems to prove most definitely that the ozonization of the water has a very marked destructive power on the bacteria present.

| No. of tests. | Number of Colonies. | | | | | |
|---|---|---|---|---|---|---|
| | Ozonized water. | | Filtered water. | | Raw water. | |
| | 1 c.c. | 1-10 c.c | 1 c.c. | 1-10 c.c. | 1 c.c. | 1-10 c.c. |
| 1 | 18 | 1 | 46 | 4 | 97 | 9 |
| 2 | 21 | 0 | 22 | 4 | 102 | 14 |
| 3 | 27 | 3 | 113 | 5 | 400 | 34 |
| 4 | 4 | 0 | 14 | 2 | 34 | 2 |
| 5 | 229 | 22 | 42 | 8 | 70 | 5 |
| 6 | 2 | 1 | 19 | 1 | 63 | 6 |
| 7 | 7 | 0 | 15 | 2 | 42 | 5 |
| 8 | 18 | 4 | 31 | 3 | 1,200 | 128 |
| 9 | 48 | 5 | 212 | 12 | ..... | 15 |
| 10 | 12 | 2 | 567 | 33 | 1,500 | 38 |
| 11 | 27 | 1 | 48 | 6 | 193 | 11 |

Examination for pathogenic bacteria.

Raw water .....colon bacilli present.
Filtered water .....colon bacilli present.
Ozonized water .....colon bacilli absent.

All the plate cultures were made under the same conditions, the temperature of the medium being 46° C., and a beef broth agar, 15 acid to phenolphthalein being used.

Conditions under which the water was obtained:—

In all cases the ozonized water was taken where it makes its entrance into the tank.

The filtered water was drawn from the receptacle into which the filters drain.

The raw water was taken from different sources as follows:—

In tests 1, 2 and 3 from the edge of the river.
Test 4 from the square filter.
Test 5 from the round filter.
Test 6 from the square filter.
Test 7 and 8 from the square filter.
Test 9 and 10 from the round filter.
Test 11 from the square filter.

All the tests, except No. 5, show diminution in the number of bacteria, from the raw water to the filtered water, and from the filtered water to the ozonized water. In test No. 5 a very peculiar condition arises, as is seen by the number of colonies on the plates. There is a diminution from 70 colonies in the raw water to 42 colonies in the filtered water. In the ozonized water, however, there was an increase to 229 colonies. The only explanation that occurs to me for this deviation from the results of all the other tests is; that a few minutes prior to the taking of the sample of ozonized water, a fire broke out in the town and a telephone message was sent to the pump-house for immediate increased pressure. The electric pump was run at its maximum speed thus causing a rapid lowering of the water in the chamber containing the ozonized water; from that a rapid lowering of the level of the filtered water, with the result that the raw water would gravitate with unusual rapidity through the filter beds, and draw with it large numbers of bacteria which had been caught in the beds. The fact that the number of bacteria was lower in the filtered water than in the raw water, and that there was a large increase in the ozonized water, might be explained by the filtered water having been drawn from the surface water which was contained in the chamber, while the increased suction caused by the high pressure pumping would draw the fresh filtered water directly towards the pipes where it mixes with the ozone and passes into the chamber containing the ozonized water;—and the ozone failing to do its work thoroughly.

In case of test No. 8 the water in the square filter was very turbid, having been disturbed from some cause which I was unable to ascertain.

Test No. 10 was made 40 minutes after washing the filter beds, the plant having been run at usual speed during this period. The raw water contained, roughly, 1,500 colonies, the filtered water 567, while the ozonized contained only 12. In the case of this test sufficient time had elapsed for the raw water to have found its way into the filters, from the filters through the ozonizing plant before the samples were taken. This test seems to prove definitely the efficiency of the ozonization of the water as having the desired effect of destroying bacteria, even when present in large numbers, provided that the plant is working under ordinary conditions.

The analysis was made at a time when the raw river water was least liable to contain many or harmful bacteria because there had been a long period drought, and consequently no liability to contamination by surface washings, from soil, manure heaps or sewage, a condition which must inevitably occur in the spring and autumn during freshets and heavy rains. The examination would be most satisfactory had the raw water been at its worst instead of its best. From the tests made, however, one should draw the following conclusions:—

1. The plant when working under ordinary conditions furnishes a water perfectly safe for drinking purposes from a sanitary and public health standpoint as it contained very few bacteria. (The maximum number being 48 and the minimum 2 per c.c.)

2. Regarding the presence of harmful organisms, both the raw water and the filtered water contained colon bacilli, while the ozonized water showed entire absence of these organisms.

3. When working under abnormal conditions such as in the case of fire, when there is a sudden rapid filtration, the ozonizer apparently failed to do its work as seen by the figures in test No. 5. I understand that the capacity of the electric pump is 1,200 gallons per minute, while the capacity of the ozonizing plant is only 700 gallons per minute. It would, therefore, seem that were the ozonizing plant of sufficient capacity to treat all the water passing through it, that a satisfactory result would be obtained.

I have the honor to be,

Sirs,

Yours faithfully,

T. D. Archibald.

## A COMPARISON OF CONTACT BEDS AND PERCOLATING FILTERS.*

**By John E. Farmer, F.C.S., Chemist, Croydon Corporation Sewage Works.**

It is difficult to give an accurate comparative cost of construction, as there are so many details affecting the cost of both methods. In this paper I have confined myself to results only, these having been obtained by the treatment of the same sewage, but not concurrently, by both methods.

The principles of the methods are identical, the application and the use of them being the difference. The principles briefly are:—(1) Exposing the liquid to be treated to a large surface area covered with living purifying agencies; ( ) keeping a vast number of bacteria in prime working condition.

In the contact method, the liquid is presented to the bacteria "in bulk," all the air between the particles composing the bed being replaced by the liquid. The bacteria are allowed a period in which to act on the liquid, which is then removed, carrying away with it the products of the bacteria. The next operation consists in giving the bacteria an air supply, by allowing a period of air contact.

| — | Ammonia, parts per million | | Oxygen absorbed 4 hours. | Grains per gallon. | | Dissolved oxygen C C S per | |
|---|---|---|---|---|---|---|---|
| | Free. | Albuminoid | | Chlorine. | Ammonias, nitrites and nitrates. | Nitrites. | Litre. |
| Tanks effluent .. | 60 88 | 5 01 | 2 50 | 6.2 | —— | —— | —— |
| half ,, .. | 1.15 | 0 52 | 0.30 | 6 2 | 3.010 | 0 0 3 | 6.3 |
| 7 ft ,, ,, . | 1 77 | 0 76 | 0.46 | 6.0 | 3 010 | 0 0 28 | 5.7 |

In the percolating method the first principle is effected by allowing the liquid to run in a fine stream over the particles covered with the bacteria, but not filling the air space, the remaining space acting as a continuous "air contact," and so allowing the process to go on for days together.

The feeding of the bacteria and the supply of oxygen proceeded simultaneously, and are not separate operations as in the contact method. The unit taken for the contact method is quantity treated per cube yard of material comprising the bed, the quantity that can be treated depending upon the available water volume left between the particles, which is found in practice, after periods of working, to decrease in some cases to a great amount.

With the percolating system the same unit is used by many, including the Local Government Board. This would make a true comparison if the modes of presenting the liquid to the purifying agencies were identical, and the volume of liquid that could be treated by percolating filters depended upon the air space between the particles; but as the liquid has to run in a stream over them the quantity that can be treated is independent of this space.

The best unit to use for percolating filters is the volume treated per square yard or per acre in twenty-four hours, especially as the depth or the cubic capacity is no criterion as to the volume which can be treated. In proof of this I give the following results of a filter constructed in two halves, and fed by a revolving sprinkler, each half having exactly the same quantities to deal with. One-half is 7 feet deep, composed of 5 feet of gravel and 2 feet of clinker, the other half being 4 feet deep, and composed of 6 inches of gravel and 3 feet 6 inches of clinker.

The average results of twenty-one samples of each half taken during a period of eleven months are given below.

It will be seen that although one-half has 75 per cent. more depth, it does not give as good a result as the other half; and taking it on the cube yard unit it should treat 75 per cent. more liquid than the lesser depth, or in other words, the 4-foot side does in proportion to the cube yard unit 75 per cent. more work with better results.

The following gives the comparison between "contact" and "percolating," as regards volume treated on the same gross superficial area, volume per cube yard unit, and the results obtained. The figures for "contact" are the total quantities dealt with and the average results for four years, those for percolating filters being for two years, so that comparison may be on the volume treated rather than on the period of working. The percolating filters were constructed on the same site as the contact beds, by converting each contact bed into four circular percolating filters, which accounts for the less nett available area of the latter. The nett available area of each method was:—"Contact," 10,019 square yards, or 13.258 cubic yards; "percolating," 7,599 square yards, or 12.664 cubic yards. The contact beds were 4 feet deep, and the percolating filters 5 feet deep.

| | Contact beds, (4 years). Gallons. | Percolating filters (2 years.) Gallons. |
|---|---|---|
| Total volume treated ..... | 892,228,000 | 962,496,000 |
| Average volume treated each square yard per day ..... | 61 | 173 |
| Average volume treated each cube yard per day ..... | 46 | 104 |

| | Average reduction on sewage. Contact beds, (4 years). Per cent. | Percolating filters (2 years.) Per cent. |
|---|---|---|
| Oxygen absorbed, 4 hours .... | 47·3 | 76.8 |
| Albuminoid ammonia ..... | 40.6 | 73.8 |

During the four years the contact beds were working they lost in water capacity 62 per cent., and at the end there was no reserve whatever, and only 68 per cent. of the sewage for which they were originally constructed could be treated.

In the case of the percolating filters, as will be seen from the above figures, they have treated during two years a greater total volume, and a greater volume per square yard, and per cube yard, this being done on a smaller total available area, and with more than one-eighth of the area resting at a time. The volume treated per day after two years' working is the same as at the commencement. The labor required for percolating filters taken on the volume treated is about one-half of that required for contact beds, the cleaning of the material not being taken into account.

One method may be better than the other to adopt according to circumstances, but many details must be considered before one can say definitely which will give the best results at the least expense.

*Paper read at the Association of Managers of Sewage Disposal Works.

## EFFICIENCY OF DAY LABOR IN THE LAYING OF MAIN WATER PIPES.

When Metcalf & Eddy, of Boston, consulting civil engineers to the Boston Finance Commission, began their investigation for that body, they found that the City Engineer had, for a number of years, kept a record of the average cost of pipe laying work performed by the Boston Water Department on jobs of similar character (that is, involving no special difficulties and no rock excavations) plotted in the form of a diagram to show progressive changes in this cost.

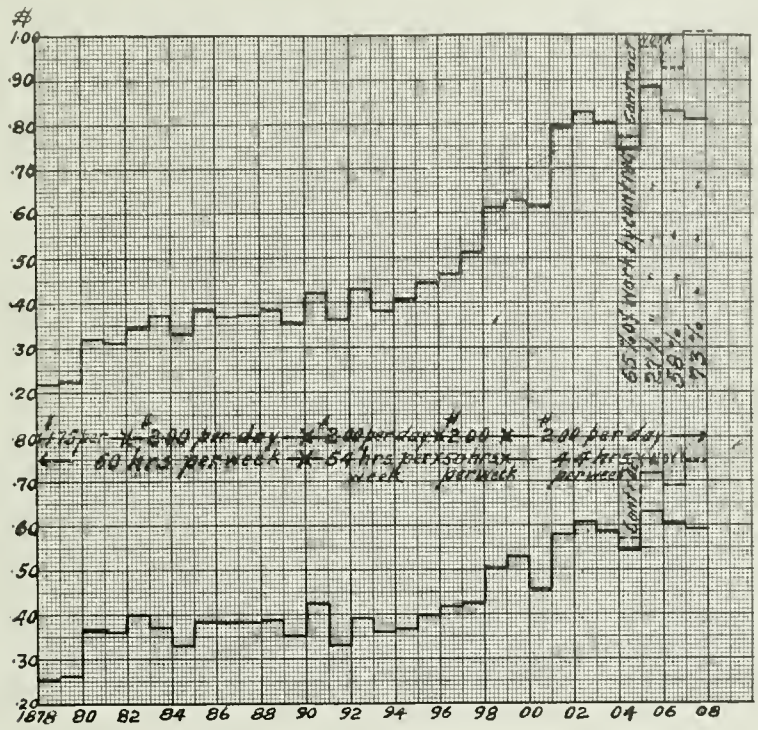
The diagram presented in the recently published report of the engineers and reproduced herewith—is in two parts, the first showing the average actual cost of labor per foot of pipe laid each year from 1878 to June, 1907, inclusive; the second showing the same information reduced to a uniform basis of wages and hours of labor. The basis selected by the City Engineer was $2 per day, and sixty hours per week. In making the reduction it was assumed that the efficiency of labor remained constant,—or in other words, that a laborer would accomplish 0.8 as much in an 8-hour day as in a 10-hour day,—and that the changes in pay had no effect upon the efficiency. If this assumption were incorrect, and, as has often been claimed by the advocates of shorter hours of labor, a man would accomplish as much, or nearly as much, in an 8-hour day is in a 9 or 10-hour day, then the efficiency per hour would evidently be increased with the decreased hours of labor, and in that event the cost per foot when reduced to a uniform basis would be lessened when the hours of labor were reduced. The diagram shows that this is not the case.

Before passing to a detailed discussion of this diagram it should be noted further that nearly all the work covered consists of laying 8-inch pipe; some 6 and 10-inch pipe has been included, and a little 12-inch. Since, however, substantially no change in the dimensions of the trench is involved in this range of pipe sizes, the cost per foot of trench should be directly comparable. In all these cases the trench is 6 feet deep.

It should be further noted that in the last four years covered by the diagram, a portion of the work included in making the averages was done by contract, viz.: in 1904, 65 per cent. was contract work; in 1905, 27 per cent.; in 1906, 58 per cent.; and in 1907 (first six months), 73 per cent. The reason for including this contract work was said to be that the amount of work done by city labor during these years was too small to get a suitable average for comparison with previous years. In these cases, however, the total cost of the contract work was increased by the cost of city labor charged to these same jobs before they were included.

The engineers' examination of the records shows, however, that if the contract work had been entirely omitted, there would still have remained 1,303, 4,168, 6,359, and 1,627 feet, respectively, of pipe laid by city labor in the four years under discussion—enough for a reasonable average which should be substantially comparable with previous years. Omitting the contract work entirely, the diagram would be changed as shown by the dotted lines which have been added. The dotted lines should then be followed, instead of the full lines, for the last four years of the diagram

A study of the lower line of the diagram shows that up to the end of 1894, although there were considerable fluctuations, the average cost was substantially uniform at about 37 cents or 38 cents per foot. From that time, however, the cost has increased at a generally uniform rate until 1902; in two succeeding years it decreased somewhat, but in 1905 rose to the highest point reached, but has decreased somewhat again in 1906 and 1907. If, however, the contract work be left out of consideration, as it should be in studying efficiency of the city's labor force, the cost is seen to rise at a substantially uniform rate, except for minor fluctuations, from 1893 to the present time.




**BOSTON WATER WORKS.**

**Diagram of Cost of Trench Work in Laying Mains up to 12 Inches.**

All work involving special difficulties omitted. Upper table shows what cost would have been if a uniform wage of $2 and a uniform working day of 10 hours had prevailed throughout the entire period.

The average labor cost per foot of pipe laying by city labor during the last three years is seen to be equivalent to about 71 cents per foot upon a basis of $2 per day, and sixty hours per week, as compared with 37 or 38 cents per foot previous to 1893, upon the same basis of wages and hours.

There seems to be no other cause to which this increase in cost can be assigned than a progressive decrease in efficiency of labor. The increase in cost has been so great and the conclusions to be drawn are so radical that the consulting engineers took the greatest care to go back to the records from which the diagram was constructed. Although they did not examine the cost records of each particular job as shown by the Water Department's books, they assumed the total cost and the total length of each job as listed by the City Engineer for this computation to be correct; and checked

TABLE SHOWING THE AVERAGE LABOR COST PER LINEAR FOOT OF LAYING WATER PIPE IN BOSTON EACH YEAR FROM 1878 TO JUNE, 1907, INCLUSIVE.

| Year. | Wages per day. | Number of jobs. | Total length of pipe (ft.). | Average length of job (ft.) | Hours per week. | Labor cost per foot in cents. Max. | Min. | Average actual cost. | Average cost reduced to uniform basis of $2 per day, 60 hours per week. | Average cost further reduced to uniform average length of job (500 ft.). |
|---|---|---|---|---|---|---|---|---|---|---|
| | $ | | | | | $ | $ | $ | Cents. | Cents. |
| 1878 | 1.75 | 9 | 4,398 | 489 | 60 | 35.4 | 17.2 | 22.3 | 25.5 | 25.3 |
| 1879 | 1.75 | 4 | 3,110 | 778 | 60 | 20.5 | 17.4 | 22.7 | 25.9 | 26.4 |
| 1880 | 1.75 | 9 | 4,258 | 473 | 60 | 74.9 | 25.0 | 32.3 | 36.9 | 36.6 |
| 1881 | 1.75 | 2 | 557 | 279 | 60 | 33.6 | 29.4 | 32.0 | 36.6 | 32.7 |
| 1882 | 1.75 | .. | ... | ... | 60 | .... | .... | 35.0? | 40.0? | .... |
| 1883 | 2.00 | 15 | 4,787 | 319 | 60 | 49.6 | 27.4 | 37.3 | 37.3 | 34.0 |
| 1884 | 2.00 | 20 | 8,710 | 435 | 60 | 75.0 | 22.0 | 33.1 | 33.1 | 32.1 |
| 1885 | 2.00 | 14 | 3,065 | 219 | 60 | 79.1 | 21.4 | 38.8 | 38.8 | 33.7 |
| 1886 | 2.00 | 29 | 7,056 | 243 | 60 | 141.6 | 21.0 | 37.1 | 37.1 | 32.5 |
| 1887 | 2.00 | 38 | 13,943 | 367 | 60 | 104.2 | 21.9 | 37.2 | 37.2 | 34.8 |
| 1888 | 2.00 | 38 | 11,203 | 295 | 60 | 119.7 | 19.5 | 38.9 | 38.9 | 35.0 |
| 1889 | 2.00 | 48 | 14,215 | 296 | 60 | 105.94 | 13.63 | 35.26 | 35.26 | 31.8 |
| 1890 | 2.00 | 30 | 6,306 | 210 | 60 | 105.0 | 15.52 | 43.05 | 43.05 | 37.1 |
| 1891 | 2.00 | 74 | 20,428 | 276 | 54 | 94.83 | 16.32 | 36.82 | 33.1 | 29.6 |
| 1892 | 2.00 | 59 | 16,527 | 280 | 54 | 242.4 | 24.0 | 43.7 | 39.3 | 35.0 |
| 1893 | 2.00 | 23 | 7,593 | 330 | 54 | 63.6 | 20.4 | 37.2 | 33.5 | 30.7 |
| 1894 | 2.00 | 45 | 19,037 | 423 | 54 | 215.3 | 11.5 | 41.3 | 37.2 | 36.8 |
| 1895 | 2.00 | 36 | 17,353 | 482 | 54 | 88.6 | 18.8 | 44.6 | 40.1 | 39.8 |
| 1896 | 2.00 | 39 | 13,975 | 358 | 54 | 282.6 | 16.7 | 47.3 | 42.6 | 39.6 |
| 1897 | 2.00 | 21 | 9,613 | 458 | 50 | 112.5 | 21.1 | 51.5 | 42.9 | 42.0 |
| 1898 | 2.00 | 22 | 10,628 | 483 | 50 | 95.8 | 36.4 | 61.3 | 51.1 | 50.6 |
| 1899 | 2.00 | 31 | 11,685 | 377 | 50 | 149.3 | 32.9 | 64.1 | 53.4 | 50.4 |
| 1900 | 2.00 | 19 | 8,502 | 447 | 44 | 99.6 | 28.2 | 63.1 | 46.3 | 44.9 |
| 1901 | 2.00 | 11 | 3,478 | 316 | 44 | 130.5 | 47.2 | 81.8 | 60.0 | 54.6 |
| 1902 | 2.00 | 14 | 8,789 | 628 | 44 | 185.6 | 60.1 | 83.4 | 61.2 | 65.1 |
| 1903 | 2.00 | 9 | 3,765 | 418 | 44 | 121.6 | 43.4 | 80.7 | 59.2 | 56.9 |
| 1904 | 2.00 | 9 | 3,704 | 411 | 44 | 93.0 | 55.6 | 74.5 | 54.6 | 52.5 |
| 1905 | 2.00 | 12 | 5,745 | 477 | 44 | 148.2 | 51.7 | 88.5 | 64.9 | 64.2 |
| 1906 | 2.00 | 22 | 15,178 | 690 | 44 | 139.1 | 57.1 | 83.3 | 61.1 | 67.2 |
| 1907 | 2.00 | 13 | 5,979 | 460 | 44 | 130.6 | 66.8 | 81.0 | 59.4 | 58.2 |

over the details of the computations and the construction of the diagram, and found the computations correct, and the diagram substantially so.

The accompanying table shows the principal figures relating to computations, giving the total length of pipe included in making up the average for each year, the maximum, minimum, and average actual cost per foot, and the average cost as reduced to a uniform basis upon two assumptions, first, that mentioned above, on a basis of $2 per day, and sixty hours per week, and second, a further reduction made by use on the assumption of a uniform average length of job each year equal to 500 feet.

It is evident that the cost per foot of any particular piece of work will vary considerably with the size of the work, since the costs of assembling the forces and getting started constitute a considerable item upon a small piece of work, and a nearly negligible item upon a large piece of work. The effect of this is indicated by the maximum and minimum costs per foot given in columns 7 and 8 of the table.

## PROTECTIVE COATINGS FOR STRUCTURAL MATERIAL.*

R. S. Perry, Philadelphia.

Although it is the intention in this address to deal especially with the subject of protecting paints, and to adhere to this subject as closely as possible, it will be necessary to outline to you in a brief way some of the scientific investigations that have led up to the subject of rust inhibition, or the prevention of corrosion.

The United States Government, two years ago, through the Department of Agriculture, started a series of tests to determine the causes of the rapid corrosion of the steel wire fences used by the farmers of the West to enclose the vast tracts of pastures and tillable lands. The complaints that the wire fences of to-day are found to corrode in less than one-fourth the time of the fences of twenty years ago have been found in many cases to be true, and the farmers and ranchers are justified in their demand for greater longevity for wire fencing.

Dr. Allerton S. Cushman, who conducted the investigations found that the absence of certain impurities in the old time Swedish charcoal iron, the material largely used for wire fencing twenty years ago, was responsible for the rust resistance of this metal, whereas the steel of modern times contains impurities that cause its rapid disintegration. Modern methods of steel manufacture necessarily demand that the product be turned out in vast quantity and with rapidity, thus necessitating the use of materials such as manganese. Such methods cannot be overthrown at once, and we must look to the metallurgist for a solution of this problem. That such materials may assert a destructive action on the steel of which they form an integral part, there can be no doubt; the difference in potential of the area containing manganese in excess, to the potential of the area containing less manganese, causes the flow of an electrical current, with the consequent effect upon the solution of the metal. Marked segregation of the impurities is another factor of a destructive nature, and causes the formation of pit-holes which are of great danger.

That these points should be given more careful consideration was made plain, very recently, on an inspection trip to the tunnels of the Manhattan and Hudson Company in Hoboken, New Jersey. Ten cars of one steel and ninety cars of another steel, that had been in service for six months, were brought into the roundhouse for examination. These cars had been built of two different grades of steel, but they were painted at the same time, with the same material and by the same workmen.

The conditions in the tunnel where these cars had been operated were most trying. Constant seepage caused drippings of an extremely corrosive nature to be deposited upon the car's surfaces, and an analysis of the drip showed the presence of 15 per cent. of chloride salts which caused rapid acceleration of rust. The tunnel drip also had a solvent action on the paint coal and in several spots the drip had completely removed the paint. The atmosphere in the tunnel was rich in carbon dioxide and high in moisture containing a considerable quantity of salt.

The large amount of rust formed on the edges of the cars could be accounted for by the abrasion of road-bed dust.

*Read before the Western Society of Engineers.

hurled against these vulnerable parts by the enormous pressure, and consequent blast, of air that is exerted when the cars are running at full speed in the tubes. Another condition observed was the appearance of a white coating of salt upon the surface of the paint after the cars had been in operation but a short time.

Subjected to these trying conditions, some of the cars stood the test in a remarkable manner, while others, made of a different grade of steel, were in very bad condition.

The points of corrosion were indicated by the surface being covered with wart-like concretions which, under a high power hand glass, showed the presence of rust forcing through the paint coat and exposing the steel to direct contact with the air. This eczema of the iron, although general, seemed to be most marked in certain places, and this would lead to the conclusion that the impurities in the metal were segregated.

According to the electrolytic theory of corrosion, certain fundamental principles underlie the corrosion of iron.

They are, briefly, as follows:—

That, when iron is in contact with water, there will be a transfer of electricity from the free hydrogen ions of the water to the iron ions of the iron, causing the solution and subsequent oxidation of the metal.

The presence of impurities having a difference in potential to that of the iron in which they are contained, and the uneven distribution of such impurities, increases the amount of electrical action.

We are indebted to Dr. William H. Walker, for the most recent research on the function of oxygen in the corrosion for iron, who says;—

"That the film of hydrogen deposited on the metallic iron at the beginning of the action is a non-conductor of electricity and prevents further passage of the current, and hence, further solution of the iron. Atmospheric oxygen removes the film of hydrogen by combining with it, thus 'depolarizing' the iron and allowing the solution of the iron to proceed. When once in solution in water, this dissolved iron is also oxidized by the atmospheric oxygen and precipitated as rust; but this oxidation is incidental to, rather than a necessary condition of, corrosion."

"That when iron is in contact with any surface on which this combination of the hydrogen, set free from the water, and oxygen, from the air, will take place more easily than on the iron itself, such as copper, bronze, mill-scale, etc., corrosion of the iron will be accelerated thereby."

Certain compounds are of such a nature as to excite electrical action, and, consequently, stimulate corrosion, while still other compounds are of such a nature as to inhibit or prevent corrosion.

To the class of compounds that inhibit corrosion belong bichromates of the alkaline earth metals, these salts being pre-eminent among such compounds. It has been found that salts of certain metals may be precipitated with the chrome salts to produce pigments which afford protection for the steel surfaces to which they are applied.

The results of a series of investigations into the rust preventive nature of these compounds demonstrated that it was not safe to state that the chromates, as a class, were rust-inhibitives. Quite the reverse is true of many of these products, and their composition, method of preparation, and impurities are factors which influence, to a marked degree, their value as protective compounds. Aside from those chromates which prevent corrosion, we have those which act in an inert manner, also those in which any inhibitive value is overbalanced by the effect of impurities, showing a strong stimulating action in the rusting of metal. But a simple test will show in which class the chromates come.

Turning, therefore, to the conservation of structural iron and steel and to its rust inhibition through particular coatings, we have the problem of choosing the proper materials for manufacturing a paint which will both exclude the agencies of rusting, and which, when moisture and gases do penetrate the coating, will inhibit the iron from rusting; and we also have the problem of giving to the chemist, engineer and architect some simple method of determining whether any given paint is, in at least a rough measure, harmful, safe or beneficial.

Some pigments largely used in the paint industry, and of value in a paint for protecting lumber, are unjustifiable in a paint for the protection of steel and iron. For example, sulphate of calcium, which, even if fully hydrated, has been shown to have a direct stimulative action upon steel. This is due to the fact that calcium sulphate, even if fully hydrated, is somewhat soluble in water, and when the water penetrates the coating of paint it carries this calcium sulphate into solution. Owing to the fact that calcium sulphate, in solution, has a high co-efficient of dissociation (or, in other words, has a tendency, in solution, to break up from its chemical form and identity), we get the reaction of the liberated sulphuric acid ions upon iron and steel, causing corrosion.

The highest type of paint product for the protection of iron and steel, therefore, avoids the use of such pigments as calcium sulphate.

Great caution must be used in selecting iron oxides for the protection of iron and steel, as they often carry traces of sulphates, etc., as impurities.

Venetian red, which is a favorite pigment, and which is of value for protecting lumber, is made by calcining green vitriol or sulphate of iron (commonly called copperas), in the ferrous form, in the presence of quick lime. The resulting mass from the furnace consists of artificial oxide of iron and sulphate of calcium, produced by the metathesis of the above reacting compounds.

Unfortunately, the reaction is never complete, and there is a tendency towards the formation of free sulphuric acid.

As a result, we have all the bad effects with Venetian red that we find in the use of calcium sulphate, and also the extra chance of corrosion due to free and aggressive sulphuric acid present.

It is true that there are some artificial oxides of iron which can with safety be used, as for instance, artificial black magnetic oxide produced by chemical precipitation, but, as a general proposition, the natural iron oxides should be used, unless it is absolutely certain that the artificial oxide has been proven safe.

Ochres are not meant to be included in the safe class in the above statements, for the reason that ochre is an extremely impure oxide of iron.

Recent investigations into the nature of pigments have revealed the fact that they may be divided into three groups and termed "Rust-Inhibitives," "Inerts," or "Rust-Stimulators." The nature of the pigment itself, or the nature of the impurities contained within the pigment, are factors deciding the position of the pigment in one of the three groups or types above mentioned. It may be expected that the use of rust-inhibitive pigments in paints designed for the protection of steel surfaces will give to such a paint very valuable properties. Further consideration of the subject will aid us in selecting the proper pigments for such a purpose.

In order to ascertain the rust-inhibitive value of all pigments, the Scientific Section was commissioned by the Bureau of Promotion and Development of the Paint Manufacturers' Association to erect a fence, having several hundred steel plates, upon which to try out the value of the different pigments when contained in an oil medium.

The American Society for Testing Materials was informed of the work proposed by the Scientific Section, and Committees E and U of that society decided to co-operate in inspecting and supervising the tests, proper specifications to be drawn up by the committees. The members of these committees and the Scientific Section conducted laboratory tests that served as a check upon the previous investigations and gave information upon which to base the main field tests. The plates used for the tests were

rolled from three kinds of metal—ordinary open-hearth structural steel, ordinary Bessemer low carbon steel, and pure ingot iron. In this way was secured data relating to the resistance to corrosion of certain metals when tested out simultaneously with others. The steel plates were painted in two ways, part of them being scratch-brushed in the ordinary way before painting, thus following out the usual mode of painting structural steel, and part of the plates being pickled in sulphuric acid, in order to completely remove the scale, and the plates were subsequently washed with lime so that all traces of the acid were neutralized.

The test was conducted in a thoroughly systematic and practical manner, following out the methods employed during the tests already made at Atlantic City and Pittsburg. The Master Painters' Association co-operated in the work and gave us the benefit of their practical experience in this line. Inspectors and painters, representing the committees and sections, were upon the ground throughout the period during which these tests were made.

It has been proven that corrosion generally takes place under normal conditions in an uneven manner, and pitting is evident at certain weak spots on nearly every grade of steel or iron, in a lesser or greater degree. From these spots the corrosion proceeds and develops upon the surrounding area. The corrosion at the start, where the pitting begins, is so extreme in some cases that holes are formed, of considerable depth, before the surrounding surface is attacked to any marked extent. The causes of this pitting have been fully explained by the electrolytic theory. This theory overthrows the former theories which were held, regarding corrosion. The carbonic acid theory, for instance, held by Calvert, supposed that carbonic acid attacked the iron, converting it into carbonate, and the carbonate being oxydized to hydrate or ordinary rust by the oxygen of the air, the carbonic acid regenerated and acting again on an unattacked part of the metal. According to the peroxide theory, the iron, oxygen and water were supposed to react to form ferric oxide, and to regenerate hydrogen peroxide which would attack a new quantity of iron. That the electrolytic theory is the most tenable has been demonstrated in many ways, but one of the most beautiful demonstrations may be carried out in a very simple manner.

A five per cent. solution of gelatine in hot water is made, and after careful neutralization, a few drops of phenolphthalein and ferrocyanide of potassium are added. A thin layer of this solution is poured upon the bottom of a glass dish, and when stiffened up by cooling, a clean strip of metal is placed thereon. A further quantity of the gelatine solution is poured upon the metal and allowed to solidify. The gelatine in this case is used to retard diffusion of the colorations which form. As stated before, when a strip of steel is placed in water, there are developed hydroxyl (OH) ions at the negative pole, and these are shown by a pink coloration formed with the phenolphthalein, whereas at the positive pole of the iron plate the development of hydrogen ions takes place, and solution of the iron proceeds. This solution forms, with potassium ferrocyanide, a blue coloration which to the paint chemist is known as Prussian blue.

It is a well known fact that zinc protects the iron from corrosion when in contact, the zinc going into solution, being electro-negative to iron, thus protecting the iron from being acted upon. It has been found that the zinc will protect the iron only to a certain extent, unless an electrolyte is contained within the water, this being due to the fact that pure water offers too great a resistance for the current to flow.

It has been shown by our investigations that certain pigments have the property of preventing galvanic action, and their use is highly desirable in a paint coating. Other pigments have been found to exhibit a strong tendency to excite galvanic action because they possess the property of being good conductors of electricity. Such pigments should never be used next to steel.

The Scientific Section of the Paint Manufacturers' Association have made a very careful and systematic study of this vital question, and are at present pursuing the work started, making tests of extreme value and recording their observations for future generalization. Such work can only be productive of the most valuable results and will ultimately result in the restriction to certain materials for use in painting iron and steel and the adoption of these materials in specifications for such work. The qualification of each and every raw product will be determined, and its legitimacy for existence in a paint will be closely questioned before giving it final approval.

It is not the intention to make any derogatory reference to certain products which are under suspicion or to attempt to tear down the business that has been built upon these products, but before we can give our candid endorsement to any raw product for use in a paint to be applied direct to iron or steel, that product must possess certain fundamental requisites which we have already outlined. The distinction between an inhibitive and a stimulative pigment may be easily determined, and it is essential to the preservation of the steel upon which such pigments are to be used, that the inhibitive principles should predominate.

That there is a marked difference in paints as well as as in steel has been proven beyond the shadow of a doubt, and evidence is collected every day confirmatory to this statement. One of our foremost metallurgists recently returned from a visit to the Isthmus of Panama, and, while there, he inspected some of the old steam engines used by the French Government, in their futile attempt to join the Atlantic and the Pacific. These engines had lain in the morass and jungle for many years, subjected alternately to the torrid heat of day and the excessive humidity of night; rare conditions for active corrosion being always present. Some of the engines were nothing more or less than a flimsy network of holes, and the material had completely gone to waste (of the open-work variety), resembling the latest thing in summer hosiery. Other of the engines had been protected with certain paint coatings that had preserved the steel intact, and the American engineers were able to pull these engines out of the morass and by substituting a few accessories, to use them again. The nature of these coatings which have withstood the test of years are at present being investigated by the Scientific Section to determine the pigments used therein.

Another engineer recently returned from Colon reports that the iron posts surrounding the consul's home and from which were suspended a line of linked chain, showed active corrosion on the south-east side in every case, while the back of the posts were slightly, if at all, affected. These posts back of the consulate were unaffected in any place because of the protection from the southeast winds afforded by the house. The winds blowing in, laden with salty humidity, had naturally exerted their corrosive effect on the surface not thus protected.

A recent examination of the steel test fences erected by the Scientific Section, at Atlantic City, was confirmatory of the above. The inspection was made early one morning, after a rainy night. The weather had cleared up and the brisk wind which had continued throughout the storm was blowing from the same direction and rapidly drying the moisture on the steel plates. The object of the inspection was primarily to determine the moisture penetration and water shedding properties of each pigment and paint. A better day or time for such a test could not have been chosen.

As has been described before, the fences are three in number, made of three classes of steel and each presenting toward the sea a series of 100 plates with as many upon the reverse side. It was apparent at once that the rain had impacted only against the steel plates facing the ocean or

shore side, and that our inspection would have to be made from the plates on the reverse side of the fence.

The panels facing the ocean and exposed to the action of the storm exhibited a variance of results. Some had been painted with pigments having a greasy nature, and being natural water-shedders were apparently dry, while others, painted with less greasy pigments, held on their surface a large number of rain drops. By wiping off these rain drops, the following differences were noted:—

(1) That in some cases a place resembling a water blister was left, showing just where the drops had remained on the surface, and showing that they were acting upon the paint coat.

(2) In other cases, when the drops of water had been wiped off, the surface was in the same condition as the balance of the plate, and the rain had no apparent effect upon the paint coat. On some panels, the penetration of moisture through the paint coat left a blotchy surface. This appearance being present on many panels, a record of impenetrability was obtained.

Very few corporations, whether manufacturing paints or buying paints, and very few engineers or architects have the facilities or the time to make exhaustive laboratory research when choice is to be made of a protective coating for their use.

What the practical man—either the paint manufacturer, the architect, or engineer—requires, is to have some practical result, easily obtainable, which will give him, in a definite and visible manner, a criterion and measure of the value of the new discovery, and of the refined laboratory work.

This accelerated field test consists in subjecting strips of any particular kind of steel that may be chosen to an atmosphere of maximum humidity, the steel being in intimate contact with the materials concerning which results are desired.

The apparatus is extremely simple, and the test can be started at thirty minutes' notice by any manufacturer, architect or engineer, at his office desk, and can yield him visible results in two days thereafter.

The idea was original with Dr. Cushman, and permission was requested from him to work it up in some practical way for the manufacturers of the raw materials and of paints, and for the consumers who have the work of protecting structural steel.

The chemist, engineer or architect who wishes to conduct this test on actual paint products instead of the materials used in the manufacture of paint products, may use a $7.50 centrifuge apparatus made by Bausch & Lomb, in other words, a small laboratory centrifugal machine holding test tubes.

Number the test tubes for reference purposes and place in each test tube a small sample of the paint to be tested, together with a large quantity of benzine. It is of extreme importance to add the benzine in considerable quantity and previous to inserting the tubes in the centrifugal machine.

Actuate the apparatus and most of the vehicle will be thrown away from the pigment and the pigment will settle towards the bottom of the tube.

Decant or pour off the oil, add more benzine, thoroughly shake and pour off the liquid. Do this two or three times until the oil has entirely left the paint and nothing remains but the dry clean pigments.

Then take the pigments and proceed with the whole test as described below for the testing of dry pigments.

The materials required are as follows:—

An ordinary deep cigar box.

2 or 3 sheets druggists' thick filter paper.

1 dozen thumb tacks.

1 dozen safety razor blades (unless some special steel is to be tested).

½ dozen small butter dishes or saucers.

Each of the dry materials to be tested.

A clean pencil for stirring.

A pocket knife.

A glass of water.

An old towel or rag for cleansing hands, pencil, etc.

A piece of emery cloth.

A tooth brush.

2 or 3 test tubes.

Line all six interior surfaces of the cigar box with the filtering paper, using the thumb tacks for the purpose. Thoroughly wet the lining of the cigar box with water and stand it on one edge so that when it is ready for use it will be free from drip.

Place upon a piece of filter paper, large enough to cover the hand, some of the material under examination, add a few drops of water and rub up with the finger into a rough soft paste, this being easily accomplished with nearly all pigments, and bringing into a paste many pigments which are otherwise extremely difficult to incorporate with water. Be particular to cut the surface of the razor blade to the raw steel with "00" emery paper, to insure the removal of any lacquer or surface treatment of the blade. It is necessary to handle the razor blades by the edges so as not to get any finger marks upon the surface. Now place a clean razor blade upon the plate, fold over the filter paper on each side of the razor blade in such a manner as to completely cover it with paste-coated filter paper, and place blade, paste and paper upon a butter dish within the cigar box.

Treat each sample of material under test in the same manner.

A word of caution is necessary regarding the testing of the inhibitives such as the chrome soaps, that are soluble in linseed oil.

These are not pigments, but soluble in oil and vehicle constituents, and therefore must not be applied in a water paste, but in a film, through the agency of benzol.

In the case of these materials, soluble in linseed oil, such as resinates and linolates, these are to be dissolved to a heavy solution in benzol, and a coating poured upon the razor blade. The evaporation of the benzol leaves upon the surface of the blade a thin film of the material to be tested, and, because of the fluidity of the benzol and consequent thinness of the film, a second coating is advisable. The coated blade is then to be placed in a butter dish within the box along with the other materials with which it is to be compared. Care should be taken that the plate is completely coated as there is a tendency for the liquid to segregate on the steel.

If a strip of steel in every case be treated with potassium bichromate in such a test, a convenient standard of minimum corrosion will be afforded, for purposes of comparison.

If so desired, in the foregoing test the operator may increase the quickness with which the test may be performed, by adding to a little bicarbonate of soda (baking soda) on a butter dish, a little sulphuric acid. An evolution of carbonic acid gas will ensue and as this gas rapidly stimulates corrosion, its presence will render the test still more positive.

A considerable degree of refinement and a fair index of result can be obtained from this apparatus if the strips are first carefully weighed in a laboratory balance, and then reweighed after the steel is scrubbed with a tooth or nail brush to remove any rust formed, in which case the loss in weight of the steel is the measure of the rust formed and the degree to which the pigment has stimulated rust.

It is evident to any man who will compare the conditions in this test with the field conditions, that practically all of the important factors which contribute to the corrosion of steel are present in this test in such a way that they will indicate in a short time the results which would be obtained from the steel painted with a paint coating produced from these materials and over a considerable length of time.

After the proper selection of pigments has been made, the question of vehicle must be carefully considered. The addition of high grade fossil resins, carefully compounded with a carefully treated oil, adds greatly to the power of a

paint to resist penetration by gases and moisture, producing a better excluding paint and at the same time adding to the appearance. The glossy surface which a paint made along these lines possesses renders the paint a better repellant or resister of moisture. The quality and percentage of gum used influences to a great extent the wearing properties of this kind of paint.

During the transportation of machinery and structural steel from the factory to the field and the workshop, there is met a state of conditions that causes rapid corrosion. Moisture and gases attack the metal and assert their destructive action. In the past these results have been partially overcome by swabbing the metal with crude oil, in some cases, and, again, by giving the metal a dip in hot linseed or other drying oils or by applying tar and cheap paints as shop coats. The crude oil leaves upon the surface of the metal, even after wiping, a quantity of non-drying mineral oil which interferes with the drying of the paint coat which is afterward applied at the time of the assembling of the metal. It also prevents the paint coat from properly adhering to the steel surface, and this coat of crude non-drying oil, which still exists between the metal and the paint coat, is a source of never-ending trouble, causing peeling and shriveling. This crude oil treatment, therefore, should be avoided whenever it is intended that the steel is to be subsequently painted with oil paints.

Where linseed oil instead of crude oil is used, a film of the oil is left upon the metal and rapidly oxidizes to a coat of linoxyn. This coat will protect the metal for a certain period of time, but is extremely porous and ultimately admits moisture. If, within this coating of linseed oil, there had been contained a proportion of pigment, or if the linseed oil had been developed by gums into a varnish or lacquer, then the excluding properties of the linseed oil would have been increased, and, if the formula were inhibitive in nature, the steel would be better protected from corrosion, and the application of future coats of paints, after assembling the steel, would have been practical and facilitated.

It is sometimes desired to give to steel a thin adherent protective coating that is transparent and will allow of the inspection of the steel by the engineer, who desires to observe whether the metal is absolutely clean and free from rust before proceeding with the painting thereof. In a case like this, there is required a coating of oil containing materials which will not interfere with the transparency of the oil coat and which, at the same time, are thoroughly inhibitive in nature. Such a compound may be prepared by the use of inhibitive chromium compounds soluble in linseed oil, such as chromium resinate or chromium linoleate. By the use of these materials within an oil coat, thorough inhibition is obtained, and, at the same time, there is added the excluding properties which these compounds afford. A thoroughly inhibitive and transparent coating is thus formed and is most practical of use. A paint coat applied to steel protected by this inhibitive oil coat amalgamates with this oil coat and becomes an integral part thereof, rendering at the same time, the oil paint thoroughly inhibitive and causing close adherence to the metal surface.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

7470—July 7—Approving location of the C.P.R. Company's Moose Jaw north-westerly branch, from mileage 148.76 to mileage 199.63.

7471—July 7—Reporting to the Governor-in-Council for sanction by-law No. 9 of the British Yukon Railway Company re spitting in cars and on premises.

7472—July 8—Directing the railway companies, subject to the jurisdiction of the Parliament of Canada, to furnish and file with the Board returns of all highway crossings on railways at which any accident has happened subsequent to January 1st, 1909, causing bodily injury or death to a person using such crossing. (Copy of Order enclosed.)

7473—May 4—Requiring all railway companies, subject to the jurisdiction of the Board, where the land on either side of railway is not enclosed, settled or improved: 1. On or before January 1st, 1911, erect and maintain on each side of the right-of-way (1) fences of a minimum height of four feet six inches, with swing gates at farm crossings, with (2) Cattle-guards on each side of the highway at every minimum height aforesaid, with proper hinges or fastenings. highway crossing at rail level; providing that sliding or hurdle gates, constructed before the 1st day of February, 1904, may be maintained. (Copy of Order enclosed.)

7474—July 6—Dismissing complaint of residents of Watford, Ont., alleging poor and unsatisfactory train service on Grand Trunk Railway.

7475—July 6—Authorizing the Ottawa Terminals Railway Co. to take certain lands at Ottawa for the accommodation of traffic at the Central Union Passenger Station.

7476—July 6—Authorizing the Canada Southern Railway Co. to construct a subway at Tecumseh Road, in the Township of Sandwich West, to be forty feet in width, with a five-foot sidewalk constructed on either side, leaving thirty feet of travelled space. To divert the Tecumseh drain and locate a water pipe along Wellington Avenue, in the same township.

7477—July 6—Dismissing application of the Brunette Sawmill Co. for an Order changing location of the V.V. and E. Railway and Navigation Co.'s railway across Lots 1 and 2, Suburban Block 1, and Lots 4, 5 and 7, Suburban Block 8, New Westminster, B.C.

7478—July 6—Approving proposed deviation of the V.V. and E. Railway and Navigation Co. from Sapperton to the Fraser River Lumber Co.'s mills at New Westminster, B.C.

7479—July 6—Granting leave to the G.T.R. and C.P.R. and other railway companies concerned to appeal from the Order of the Board made in the complaint of the British Oil Co., of Toronto, May 19th, 1909, to the Supreme Court of Canada, in the question of law involved in the making of said Order.

7480—July 6—Directing that St. Phillipe, St. Ferdinand and Metcalfe Streets at St. Henri, Montreal, be protected between the hours of 6 a.m. and 7 p.m. by watchmen to be appointed by the G.T.R.

7481—July 6—Directing the C.P.R. to provide and construct a suitable highway crossing over its railway at Gainsboro' Avenue, Township of Nepean.

7482—July 7—Dismissing complaint of Dominion Millers' Association respecting charges of the C.P.R. for the elevating and storage of grain at Fort William, Ont.

7483—July 6—Dismissing application of the town of Campbellford, Ont., for Order directing the G.T.R. to provide better passenger and train service connections between Campbellford and Toronto, Ont.

7484—July 9—Authorizing Canadian Northern Quebec Railway to construct its lines and tracks across public road between Lots 273 and 274, Parish of St. Stanislas, Que., at mileage 69.77 west of the Quebec bridge.

7485—July 9—Authorizing the Canadian Northern Quebec Railway to construct its lines and tracks across public road on Lot 301, Parish St. Stanislas, at mileage 69.30 west of Quebec bridge.

7486—July 6—Dismissing complaint of J. B. Grenier, of St. Tite, Que., alleging inefficient and unsatisfactory train service of the Canadian Northern Quebec Railway between Quebec and Montreal, and of lack of station accommodation at Heronville, Garneau and St. Tite, Que.

7487—July 10—Authorizing the C.P.R. to construct a bridge at mileage 97.8 on the Windsor section, Ontario Division, and rescinding Order 5796, April 8th, 1909, in so far as it authorizes the construction of the said bridge.

(Continued on Page 103.)

## FREDERICTON MECHANICAL FILTER PLANT.*

Fredericton is situated on the St. John River and has a population of about 8,000.

The water supply is drawn from the river through a 15-inch riveted steel suction this taking the water from a crib pier 150 yards from the shore conveys it by gravity to a pump well located adjacent to the waterworks station. From the pump well the water is raised by two six-inch centrifugal pumps direct connected to reciprocating engines with capacity of 1,400 gallons per minute. These pumps raise the water to the coagulating basin (54 feet by 22 feet 3 inches), capacity 90,000 gallons, divided completely into two chambers to allow for the alteration of the period of coagulation to suit the varying conditions of the river. From the coagulating basin the water flows by gravity through the filter beds (10 feet by 15 feet) at the rate of 125 million gallons per acre per day to the clear water reservoir situated below the filter building. The clear water basin has a storage of 470,000 gallons.

The coagulating basin, filter tanks and clear water basin are constructed of concrete. The supply and effluent are controlled by hydraulic gates as are also the connections for cleaning the filter beds.

The water supply for the city is lifted from the clear water basin and supplied directly to the city by a cross compound Corliss Engine, manufactured by Allis-Chalmers-Bullock, Limited, which has a capacity of 3,000 gallons per minute. There is also a Gaskill Engine connected to the reservoir for emergencies. Both of these engines are also arranged to pump directly from the river.

From the above record the following Table is deduced showing the percentage of reduction in color due to the application of one grain of alumina sulphate per gallon:—

By an examination of the above table the following the deductions seem justified:

1. The color of the St. John River water is reduced a larger per cent. per grain of alumina sulphate used when the water carries from five to twenty parts per million of turbidity.

2. That when the color of the same water is fifty parts or more per million (platinum standlard), a larger percentage of color is removed per grain of chemical than when the color falls below this point.

* From the report of A. K. Grimmer, B.A.I., City Engineer, of Fredericton, N.B.

**Table Showing Colour Reduction by Months.**

| Month | Average color of raw water. Platinum standard | Average turbidity of raw water | Grains alumina sulphate per gallon | Percentage of removal of color per grain per gallon | Remarks. |
|---|---|---|---|---|---|
| | Parts per Million | | | | |
| May | 80.5 | 21 | 1.46 | 41.8 | Note.—That where the table shows no turbidity for any month the intention is on certain days there was slight turbidity but it was not considered advisable to make the average of these to represent the month. |
| April | 62.7 | 15 | 1.56 | 35.0 | |
| June | 78.2 | 10 | 2.02 | 30.9 | |
| March | 55.4 | 5 | 1.66 | 29.9 | |
| December | 50. | 2 | 2.43 | 27.3 | |
| August | 52.7 | 0 | 2.16 | 27.3 | |
| July | 48.6 | 0 | 2.22 | 27.0 | |
| November | 51.0 | 2 | 2.11 | 26.5 | |
| January | 55.6 | 0 | 2.22 | 26.1 | |
| February | 44.0 | 0 | 2.32 | 26.9 | |
| October | 48.6 | 3 | 2.27 | 25.4 | |
| September | 48.6 | 0 | 2.71 | 24.1 | |

These facts having been noted in the daily operation experiments were made in the laboratory for the purpose of checking these results, and determining if possible the saving in chemical which could be made by the mechanical application of a specified quantity of turbidity. The following table shows the summary of experiments and results:—

The following table shows in detail the monthly operation of the filter plant:—

**Record of Filter Plant Operation, 1908:**

| MONTH | Total water filtered per month in gallons | Daily average in gallons | Per cent. wash water used on filter beds | Total per cent. wash water | Air application in mins. | Turbidity (raw) | PARTS PER MILLION Colour Platinum Standard Raw | Colour Eff. | Alkalinity Erythrosine Method Raw | Alkalinity Eff. | Alumina Sulphate in grains per gallon | Per cent. reduction of colour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 16,801,600 | 553,385 | .87 | .92 | 7.0 | 0 | 55.6 | 23.3 | 41.8 | 22.8 | 2.22 | 50. |
| February | 16,244,490 | 560,155 | .82 | .89 | 7.3 | 0 | 44.0 | 11.5 | 42.5 | 21.5 | 2.32 | 60. |
| March | 15,781,800 | 509,020 | .75 | .80 | 8.1/ | 5 | 55.4 | 28.8 | 37.2 | 23.3 | 1.66 | 48.0 |
| April | 16,448,510 | 548,284 | .69 | .76 | 8.5 | 15 | 62.7 | 28.5 | 35.1 | 22.0 | 1.56 | 54.5 |
| May | 16,960,650 | 547,118 | 1.05 | 1.12 | 6.5 | 21 | 80.5 | 31.1 | 23.3 | 10.5 | 1.46 | 61.1 |
| June | 16,357,450 | 545,248 | .78 | .82 | 7.8 | 10 | 78.2 | 29.3 | 31.2 | 14.3 | 2.02 | 62.5 |
| July | 16,525,080 | 635,580 | .75 | .79 | 8.3 | 0 | 48.6 | 20.5 | 39.5 | 20.2 | 2.22 | 59.9 |
| August | 19,806,550 | 703,437 | .68 | .75 | 8.4 | 0 | 52.7 | 21.6 | 40.5 | 22.4 | 2.16 | 59.0 |
| September | 17,211,200 | 573,706 | .72 | .77 | 8.0 | 0 | 48.6 | 16.8 | 44.4 | 23.7 | 2.71 | 65.4 |
| October | 16,174,190 | 521,747 | .69 | .73 | 8.0 | 3 | 48.0 | 20.5 | 48.0 | 24.8 | 2.27 | 57.8 |
| November | 15,977,650 | 532,588 | .74 | .77 | 7.4 | 2 | 51.0 | 22.5 | 42.0 | 24.5 | 2.11 | 56.0 |
| December | 16,486,600 | 531,822 | .78 | .83 | 7.5 | 3 | 56.0 | 20. | 39.5 | 19.1 | 2.43 | 65.4 |
| 1908 | 200,775,770 | 563,513 | .77 | .83 | 7.7 | .. | 56.8 | 23.3 | 38.7 | 21.1 | 2.09 | 58.7 |
| 1907 | ..... | 544,000 | ... | .63 | ... | .. | 84.2 | 32.8 | 34.9 | 17.9 | 2.17 | 61. |

**Table Showing Experiments on Color Reduction.**

| No. of experiments from which average was deduced | Turbidity added. Parts per 1,000,000 | PARTS PER MILLION Colour Raw | Colour Eff. | Alkalinity Raw | Alkalinity Eff. | Alumina sulphate in grains per gallon | Percentage of colour moved per grain per gallon |
|---|---|---|---|---|---|---|---|
| 4 | 0 | 59 | 17.5 | 40 | 19.3 | 2.35 | 30. |
| 2 | 5 | 59 | 15.0 | 38 | 19.0 | 2.40 | 30.8 |
| 4 | 10 | 59 | 13.5 | 40 | 20.0 | 2.35 | 32.0 |
| 2 | 12 | 58 | 12.0 | 38 | 19.5 | 2.40 | 33.0 |
| 4 | 15 | 59 | 11.0 | 40 | 20.0 | 2.35 | 34.4 |
| 2 | 18 | 58 | 10.0 | 38 | 19.5 | 2.40 | 35.0 |
| 5 | 20 | 68 | 20.0 | 38 | 20.0 | 2.40 | 28.0 |
| 4 | 25 | 75 | 21.0 | 38 | 20.0 | 2.40 | 36.0 |
| 4 | 30 | 68 | 18.0 | 38 | 20.5 | 2.40 | 37.0 |

The experiments proved the records in as much as they show that an addition of turbidity increases the decolorizing action of the chemical, however, it should be noted that the laboratory experiments did not show as large an increase in the percentage of removal as was indicated by the daily records, and further that the reduction of alkalinity per grain of alum used decreased with the addition of turbidity.

It is a peculiar fact that the color of the St. John River water is harder to remove than is the case of any other plant whose records have been available or whose operation was personally observed. This is probably due to the fact that coloring matter in the water is caused by bark, lumber and other vegetable matter which reaches the plant in the form of tannins. A series of experiments will be conducted this year with a view of determining whether it would be advisable to hold this water for a period before treating it chemically thus giving the coloring matter a chance to decompose in which state it is believed the chemical would reduce the color by a much larger per cent.

From the annual record of the Provincial Board of Health the following table has been deduced showing the cases of typhoid per month and year, as far back as it has been possible to do so with accuracy:—

**Cases and Deaths from Typhoid in Fredericton, compiled from Board of Health Records, 1895-1908.**

| DATE | | January | February | March | April | May | June | July | August | September | October | November | December | Total Cases | Total Deaths |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1895 | C | | | | | | | | | | | | | 66 | |
| | D | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 6 | 2 | 0 | | 13 |
| 1896 | C | | | | | | | | | | | | | 22 | |
| | D | | | | | | | | 1 | | 1 | | | | 2 |
| 1897 | C | | | | | | | | | | | | | 19 | |
| | D | | | | | 1 | | | | 1 | 1 | 1 | | | 4 |
| 1898 | C | | | | | | | | | | | | | 71 | |
| | D | 1 | | | | | | | | 1 | | | | | 2 |
| 1899 | C | | | | | | | | | | | | | 23 | |
| | D | | | | | | | | 1 | | 1 | | | | 2 |
| 1900 | C | | | | | | | | | | | | | 22 | |
| | D | | | | | | | | 1 | | 1 | | 1 | | 3 |
| *1901 | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| 1902 | C | 3 | 5 | 6 | 3 | 1 | 2 | 3 | 5 | 2 | 5 | 3 | 3 | 41 | |
| | D | | | | | | | | | | 2 | 1 | 1 | | 4 |
| †1903 | C | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | |
| 1904 | C | 5 | 11 | 4 | 3 | 1 | 1 | 6 | 2 | 1 | 3 | 13 | 2 | 52 | |
| | D | 1 | 1 | 1 | | 1 | | | | | | 1 | | | 5 |
| 1905 | C | 4 | 9 | 40 | 27 | 6 | 0 | 3 | 1 | 1 | 6 | 8 | 3 | 108 | |
| | D | | | 2 | 1 | 1 | | 1 | | 1 | | 3 | | | 9 |
| 1906 | C | 4 | 5 | 5 | 8 | 5 | 0 | 3 | 1 | 5 | 6 | 11 | 9 | 62 | |
| | D | | 1 | | 1 | 1 | | | | | | 1 | 1 | | 5 |
| 1907 | C | 5 | 6 | 15 | 17 | 30 | 8 | 1 | 1 | 1 | 1 | | | 85 | |
| | D | | | | 1 | 1 | | | | | 1 | | | | 3 |
| 1908 | C | 2 | 2 | 1 | 2 | 3 | 0 | 3 | 2 | 4 | 4 | | | 23 | |
| | D | | | | | | | | | | | | | | 0 |

The Provincial Board of Health returns show deaths from typhoid every year back to 1888.

Previous to the installation of the filter plant the average number of typhoid cases per year was 55, or practically 1 per cent. of total poulation had typhoid fever every year, and an average death rate of 9.7 per cent., since the installation of the filtration the average number of cases per year is eighteen and the percentage of mortality has been reduced to 3.7 per cent. From personal examination and information obtained from the Local Board of Health, it has been ascertained that 80 per cent. of the cases of typhoid which have occurred since the installation of the filter plant would probably be due to local sanitary conditions on the premises, and it was further learned that two cases, approximately 10 per cent. were contracted outside the city, leaving 10 per cent. of the cases unaccounted for.

During the past summer the centrifugal pumps which supplied the raw waters to the filters were found to be inadequate in size and the contractors were obliged to install

**End View of Filter Building and Power-House.**

pumps with larger capacity, and are now operating satisfactorily. During the period which was required to construct larger pumps, the Gaskill Engine was used to supply water to the filters, but it was found to be practically impossible to supply water to the filters uniformly, and the chemical therefore was not applied with a uniformity sufficient to develop a high bacterial efficiency. The installation of the larger pumps was completed during the latter part of the month of October last. It will be noticed by reference to the table of typhoid cases, that the months of September and October showed an increase in the number of cases, which may or may not be due to the irregularity in the pumping, but which at least is a peculiar coincidence. The new pumps have proved most satisfactory and there have been no cases of typhoid reported since the first of November which fact strengthens the argument that the

**Interior of Operating Room.**

increase of typhoid during the months of September and October was due to irregularity of operation.

During the last year several sets of measurements were taken to ascertain the accumulation of sludge in the coagulating basin. Measurements were taken at six different points daily, the average of which would represent the average depth at the time in the basin. From these measurements it was possible to deduce a curve representing the decrease in volume of the coagulating basin and thus deter-

* 1901. Board of Health records give only deaths for this year.

† 1903. Board of Health records give only deaths for this year.

mine definitely the coagulation period which has proved to be one of the most essential features in the operation of this plant.

The Provincial Board of Health in its report to the Lieutenant-Governor in Council makes the following comment on the filtration plant and its results:

"It is with great pleasure and satisfaction that we have to report that the large expenditure made by the city in the inaugurating of a most perfect filtration plant in connection with their water supply from the St. John River, and their modern system of sewerage, has been fully justified by the results shown in the general health of the city as appears on examination of the statistics hereto appended. Typhoid fever, heretofore the blight of our otherwise most healthy city has been eliminated as an epidemic and from the present year's results we may fairly hope for and look forward to a continued improvement in the general health of this district as the result of these great sanitary improvements."

**Filtration Plant Operating Expenses.**

Cost of operation, exclusive of interest charges, $1,451.33. This, however, does not take into consideration the fact that the city at the end of the fiscal year 1907 had 34,875 pounds alumina sulphate in stock, which should be charged to 1908. This would otherwise have been an extra expenditure $553.38, or a total expenditure for 1908 of $2,004.71 for the operation of the plant.

## SOME SUGGESTIONS REGARDING FORMS FOR CONCRETE HIGHWAY BRIDGES.*

**By F. A. Peterson, Fairmont, Minn.**

Reinforced concrete, for the construction of bridges and culverts, is superior to any other material that has been employed for such purpose. If properly made, it is not affected by storms, winds, or floods, and not subject to decay, rust or disintegration. It requires no paints or protection, no new floors to repair, and is constantly getting stronger and better with age.

The art in concrete bridge designing is its simplicity. There is at this time no form of bridge construction more simple and effective than the straight-beam design. It has the advantage of an unobstructed water-way and is somewhat cheaper than the arch design on account of the cost of forms.

Those contemplating building bridges of concrete should employ a competent engineer to draw the plans. Do not think of doing it yourself. If you undertake this class of work, failure will surely overtake you. I have heard many contractors complain that most engineers were too exacting in their specifications. In most cases they have themselves to thank. If the contractor is honest in his work and is willing to do the right thing, he will soon get the confidence of the engineer and the two will work together in harmony.

The cost of building concrete bridges, compared with steel, will vary somewhat according to location. I believe reinforced concrete bridges for county purposes can compete in price with the combination iron bridges that have been built in the past. The up-keep for the concrete bridges is nothing compared to the painting and repairing of iron bridges.

One of the difficulties to be met with in the construction of concrete bridges is the procuring of suitable labor, and the average carpenter, who has no experience in building forms, is of very little help to you. He does not realize the enormous weight that the timber has to bear and therefore, as a rule, does not build the centering strong enough. By employing a man used to building forms, much lumber will be saved. Usually too many nails are used in the work, causing a loss of time in building and ruining a large amount of material. No. 7 nails will generally be found large enough. Bracing can be done away with largely by using bolts, and the average man who does the bracing does not do it as it should be done, causing delay and loss. When bolts are used and well greased, they can be readily released at any time.

*Read before the Northwest Cement Products Association. Minneapolis, Minn.

**Examination of the Site.**

Before bidding on your job, examine the soil, bore down, and find what foundation you have to contend with. If you find any quicksand you must expect trouble, and your bid must be in accordance with the foundation you find. Insist on having the location and height of bridge to be built staked out so that there will be no question afterward.

Your bid will be governed largely by the distance your gravel and sand will have to be hauled. If your work is over a river, generally a good quality of sand and gravel can be found in pockets, but it is frequently mixed more or less with a large percentage of clay and shale. Be very careful of this material. One engineer declares that a 1:2:4 mix is extravagant, when a 1:3:6 mix will do just as well. This is rather misleading. The writer will admit that if the proper sand and aggregates can be procured, the 1:3:6 mix will do for the footings, abutments and wings, but where one has to procure the material in the country, the 1:2:4 mix is safer to use, on account of the class of material generally found.

Much has been said and written regarding the proper amount of water to be used in concrete, where it is to be poured, as is generally the case in bridge building. Concrete made as thick as cream is preferable under general conditions, but the mass should be thoroughly churned with paddles to dispose of the air. There are times and places when one should know when not to use very sloppy concrete. For instance, when filling bridge beams with concrete, where usually a network of reinforcement is used, judgment must be used so that the reinforcement will not hold back the coarse material, and allow the fine to pass to the bottom of the beam, thereby causing an arch under which there is no support, making your concrete uneven in aggregates and consequently weakening it in strength. The foreman should be constantly on the watch for errors of this kind.

**Cost of Forms.**

The cost data for form work in bridge building are misleading. The writer believes that there is a greater opportunity for investigation in the construction of centering and form building than in any other branch of concrete work. It is generally estimated that it costs from forty to fifty per cent. of the total cost of concrete in any building for form work. The system known as the "two-board form method" is a great improvement over the old style, and when the forms can be successfully made of steel, a still greater saving can be made. When your forms are all erected, be careful that your lines are in place and see that your work is measured a second time so that everything is true and in line. In placing your steel, keep strictly to your plans; see that every piece is placed as directed. Too much care cannot be exercised in that branch of the work. Do not neglect wiring, just because it is a little tedious. Have the wire cut about eight inches long before you begin your placing of steel. Number 18 wire is generally used by the writer for wiring rods together. If it is necessary to use stronger wire, just double the Number 18. See that all the steel is placed before pouring concrete. See that all sawdust and dirt are removed before placing steel, and that your lumber is thoroughly wet before concrete is placed.

**Tools Needed in the Work.**

Now a few words about a few of the tools needed: An anvil, a small forge, a few cold chisels, crow-bars, sledge hammers, post mauls, a good strong vise, tanner's nips, pliers, wire cutters, several claw pullers, several pieces of steel bars with both ends turned, to be used in taking the forms from the concrete; a few locomotive jacks, in case of forms giving way; grindstone, pipe cutters, stock and dies, taps and dies for bolts.

Nearly all of these you will find are indispensable. Your steel should be ordered the proper lengths from the factory, but the bending will have to be done at the job. Nearly all

(Continued on Page 103.)

# LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

**[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]**

## CONTRACT—CARRIAGE BY WATER—BUSHEL.

**Mellady vs. Jenkins Steamship Co.**—The defendant company were an American company running steamers of United States registry from Chicago. The vessel they supplied in this case was an American vessel, and of American register. The plaintiffs by agents in Toronto, opened negotiations with the defendants in Chicago for the carriage of oats from Fort William to Buffalo. These communications, after being carried on for a number of days, culminated by the Chicago brokers wiring the Toronto people, offering the steamer named "The Squire" to carry 90,000 bushels of oats at 2½ cents per bushel, and the plaintiffs, in reply, telegraphed, accepting the offer. It then followed that the steamer "Squire" proceeded to Fort William, where she loaded oats (98,163 bushels), which were received by the ship at 34 pounds per bushel. It transpires that 34 pounds to the bushel is the Canadian standard, but the United States standard is 32 pounds to the bushel. The oats were duly carried to Buffalo, and, upon their delivery there, freight was claimed by the vessel and paid by the agents of the consignees at the rate of 2½ cents per bushel of 32 pounds instead of per bushel of 34 pounds, and the shippers brought an action for the additional freight they had been forced to pay, the steamship company, on the other hand, claiming that upon paying the freight all right to object to the amount had been lost.

The Court held that, inasmuch as refusal to pay would have resulted in demurrage and other loss, the amount was paid perforce, and it could not be said it had been agreed to or any rights waived by making the payment.

The case, indeed, calls up an interesting point as to the formation of contract. It is an established principle in English law, which also applies in the United States, that where two parties adopt a common means of communication, as, for example, the post-office, then that common agent is equally identified with both, so that the contract is complete as soon as a letter of acceptance is mailed, and even before that letter has been delivered. Thus, too, in this case, both parties, if not in the earlier stages, did finally accept the telegraph company as their common agent. The offer was wired from Chicago to Toronto and was accepted by the return telegram. Therefore, the contract was completed, or, in other words, made in Toronto, and, therefore, it was to be supposed that the Canadian customs and standards would apply. In addition to this is the fact that the cargo of oats when loaded at Fort William was received by the steamship company as measured by the Canadian standard of 34 pounds to the bushel.

The Courts have held that freight could only be legally demanded at 2½ cents per 34 pounds, and that the balance must be refunded. 18 O.L.R., 251.

## CLOSING OF HIGHWAY.

**Taylor vs. Village of Belle River.**—The council of the village of Belle River passed a by-law in August, 1908, providing for the closing of part of the Tecumseh Road through the said village, and Taylor, one of the ratepayers, moved to quash the by-law as ultra vires of the council. By Sec. 637 of the Ontario Municipal Act, 1903, municipal councils have power "for.....stopping up roads .....**wholly** within the jurisdiction of the council." It was contended that "wholly" applied to the territorial limits of the roadway, and, therefore, the council could not close a road which passed through several municipalities; but the Court held it applies not to the locality of the road, or part of road, but refers to the question whether any other council or person has any control over that particular road or portion of road. They held, therefore, that the council may close that part of a highway lying within its own limits, although the road is a general highway extending from township to township. 18 O.L.R., 330. It seems probable, however, that in closing such a road the council would be bound to open up some other highway in substitution for same.

Any unlawful stopping or diversion of a public highway is an obstruction, and amounts to a criminal offence. "Once a highway, always a highway," and a highway cannot be stopped or diverted except by special Act of Parliament, or following the provisions of some general Act. In Canada this power of Parliament is handed over to the Provincial Legislature. It is the duty of local councils to protect public rights-of-way within their confines, and they cannot proceed to close or otherwise interfere with any highway except by such precise methods as the Legislature has prescribed.

## DRAINAGE—OUTLET FOR WATER.

**Hiles vs. Township of Ellice.**—The Township of Ellice, wishing to drain certain lands within their own township, exercised the powers given by the Municipal Act of carrying the work into the lower adoining Township of Elma, for the purpose of finding an outlet, without any petition from the owners in the adjoining township. The plaintiff claimed that the defendants did not carry the drain to any proper outlet, but brought in the water from the Township of Ellice and deposited it on the land in Elma at a point from which it spread over several lots, eventually reaching his land, where it lay, to the detriment of his farm and crops.

Held, that a municipality constructing a drain cannot let water loose just inside the boundaries of, or, indeed, anywhere within an adjoining township, without being liable for injury caused to surrounding lands.

Held also, that a tenant of the lands injured can maintain an action and recover damages for such injury as results during his occupation. During the term of lease his rights rest upon the same basis as if he were a freeholder. 23 S.C.R., 429.

Where the owner of lands is thus injured he has two means of redress, and may suit himself as to which he will follow. He may apply for arbitration to the drainage referee, and thus assess his damages, or he may issue a writ for the amount of the injury he has sustained and obtain judgment of court. 25 O.A.R., 226.

## CONFIDENTIAL RELATIONSHIP—SPECIFIC PERFORMANCE.

**Henderson vs. Thompson.**—The plaintiff, who lives in Rossland, B.C., visited the defendant, Mrs. Thompson, who lived in Seattle, Wash., and ascertained that she was willing to sell a house and lot which she owned in Rossland; and he offered to act in a friendly way for her in helping her to secure a purchaser. Upon his return to Rossland he opened up correspondence with her, representing that he was in

touch with prospective buyers, whom, however, he did not name. He informed her that the house was in a dilapidated condition, and, therefore, a good price could not be obtained, and advised her to accept the offer made, which she did. Later, when she discovered that the plaintiff and his wife were themselves the purchasers, she refused to carry out the sale, and they brought this action to force her to convey to them.

It was admitted that the defendant thought the plaintiff did not want the property himself, but only wished to befriend her in finding a purchaser. He refused, indeed, her offer to pay him a commission for his services, but that, of course, made no difference, as he left her clearly under the impression that he was nevertheless to act as her agent in the prospective transaction.

When he returned to Rossland he continued the misrepresentation, and led her by letters to believe that he was in treaty with some third parties for the purchase, and advised her to accept that third party's offer as being the best he could get out of them. As a matter of fact, it transpires that the third party was his wife, and that he himself had an interest in the purchase. He, therefore, occupied a position where his interest and his duty conflicted, and the authorities are conclusive that, in such cases, where there is a non-disclosure of that which it was the plaintiff's duty to disclose, no specific performance can be granted. In this case there was not only non-disclosure, but misrepresentation of material facts.

The plaintiff's action was dismissed with costs, 41 S.C.R., 445.

In the days when English law was in the evolutionary stages the courts knew nothing of such a process as enforcing specific performance of a contract. If one man refused to carry out his contract, the other party could institute an action for damages, and these, if obtained, would be proportioned to the seriousness of the loss or injury suffered by reason of the breach of contract. Then the plaintiff must proceed to collect his judgment, which was in many cases useless, as the defendant was not a man of substance, and thus the legal remedy was really a farce.

A secondary practice arose later in allowing the injured to elect to proceed for damages as above or sue for performance of the contract. The older remedy was based upon strict law, and if a plaintiff could prove a breach, he was entitled to a judgment, be it ever so small; but the new process was based upon equity and good conscience, and the Courts would refuse to help him if his own conduct had not been open and honorable. In the case above the plaintiff proved the existence of the contract, but the Court refused to enforce it because obtained by dishonorable means.

(Continued from Page 101.)

of it should be bent cold; unless you have an experienced blacksmith there is danger of overburning your steel, thereby weakening your material.

Most of your outside forms can be removed the next day after the concrete has been placed, by wetting the concrete thoroughly. Then apply a 1:2 mix of fine sand, brushing and rubbing down with a carborundum stone. This gives the surface a very smooth and pleasing effect.

Last but not least see that all plank walks and scaffolding are rigid and strong, preventing any cause for accidents. This one item alone may save you an expensive law-suit. Take no chances.

## RAILWAY ORDERS.

(Continued from Page 98.)

7488—July 9—Directing the G.T.R. to provide a night watchman at Wellington Street crossing, Hamilton, Ont.

7489—July 9—Authorizing switching connections between the Bay of Quinte Railway and the Kingston and Pembroke Railway at Harrowsmith, Ont.: Bay of Quinte Railway to install and maintain semaphores at its own expense on each line of railway.

7490—July 6—Authorizing the Canadian Northern Ontario Railway Co. to cross and connect the tracks of the Ottawa and Prescott Railway Co. at mileage 56.6 west from Hawkesbury, Ont.; interlocking plant to be installed.

7491—July 9—Approving Canadian Northern Ontario Railway Co.'s freight tariff, C.R.C. 74, for use on the company's line of railway east of and including Toronto and Sudbury.

7492—July 6—Refusing application of corporation of Township of Rochester for Order varying Order No. 6981, May 10th, 1909, authorizing the construction by C.P.R. of Bridge No. 92.1 on Windsor section, Ontario Division.

7493—July 10—Authorizing the Canadian Northern Ontario Railway to open for traffic that portion of its line from South Nation River to Rockland, a distance of twelve miles.

7494—July 7—Disallowing Canadian Express Company's notice of cancellation of rate of 30 cents per 100 pounds on freight shipments from Queenston, Ont., to Toronto, Ont., which was made effective by the company on 14th June, 1909.

7495—June 25—Directing the G.T.R. and Bay of Quinte Railway Companies to publish and file with the Board a joint rate on bituminous coal from Black Rock, N.Y., and Suspension Bridge, N.Y., to Marlbank, Ont., of $1.43 per ton of 2,000 pounds on a minimum weight of fifteen net tons per carload, except in case of cars having a less marked capacity than fifteen net tons, the said marked capacity, but not less than twelve net tons shall be the minimum carload weight. Rate to become effective not later than 23rd August, 1909.

7496—July 6—Authorizing town of Prescott, Ont., to lay and maintain a sewer outlet pipe across tracks of C.P.R. at Prescott.

7497—July 10—Approving by-law of the Atlantic, Quebec and Western Railway Co. authorizing Alphonse Lemieux, general manager of the company, to prepare and issue tariffs to be charged for all traffic carried on its railway.

7498—July 6—Dismissing application of Herbert Bingham and Joseph Quenneville, of Crysler, Ont.; Robert Stevens and Thos. Fleming, of Township of Finch, and Louis A. Landry, Township of Cambridge, for an Order directing the Ottawa and New York Railway to rebuild its railway station at Crysler, Ont., at a point on the north-east side of its railway line about 1,657 feet in a north-westerly direction from the site of its previous station.

7499—July 6—Dismissing application of the Montreal Park and Island Railway for authority to extend its line of railway along St. Denis Street, Montreal.

7500—July 7—Dismissing application of the Manitoba Grain Growers' Association for Order directing C.P.R., C.N.R. and G.T.R. to reduce their charges for the elevating and storage of grain at terminal elevators at Fort William and Port Arthur, Ont.

7501—July 13—Authorizing the C.P.R. to construct its railway across the highways in Township of Tay at mileage 2.98, 3.05, 5.36, 8, and 9.14.

7502—July 8—Approving location of the Union Station of the C.P.R. and C.N.R. at Maryfield, Sask.

## EXPERIMENTS MADE AT GARDEN CITY, DODGE CITY, BUCKLIN, AND FORD, KANS., WITH SAND-CLAY.*

In the semi-arid portions of Kansas and Nebraska there is an extensive area of sand hills. These hills are usually parallel to the rivers, and vary in width from a few hundred yards to several miles. They are continually shifted by the winds, and hence road building in this region is a difficult problem. Good road material is scarce and the country is sparsely settled. In many localities there are no road m-

* From information furnished by the Public Roads Department of the Department of Agriculture, U.S.

terials except an alkali soil, gypsum clay, or a gumbo-like sedimentary clay.

### Experiment at Garden City, Kans.

At this point sand hills run parallel to the Arkansas River on the south side, and form a strip nearly seven miles wide. A careful inspection of the vicinity revealed no available road material except occasional deposits of gypsum clay distributed irregularly across the sandy belt. From two of these deposits was taken the material used in the construction of the road at this place. The first pit was opened about 900 feet east of the road and the other near the roadside. From the first pit 68 cubic yards was hauled, but it was then abandoned because of the distance of haul, and because the clay showed a lack of binding power. The road was completed with material from the second pit. The farther down in the pit the stickier was the clay and the better it compacted after the addition of sand.

The problem to be solved in this case was the best method of handling the local material, gypsum clay, so as to produce a road with a wearing surface capable of resisting the action of the constant winds, which are generally from the south. For this experiment a section of road 765 feet long, situated on the slope of a sand hill, was selected.

The clay was hauled directly upon the road, down the centre of which a width of 12 feet had been staked. The clay covering was spread to a depth of about nine inches immediately after it had been dropped on the road. The clay was hauled over the loads previously deposited and all holes so made were filled at once. Traffic was allowed upon it, and this compacted the clay firmly. During the time of hauling the clay no rain fell, but after the hauling was completed a heavy rain soaked the clay, and the road was finished as follows: While the road was wet a spike-toothed harrow was put on and the clay completely pulverized. Then five furrows were backfurrowed on each side of the clay, thus raising the sand shoulders above the clay centre. A split-log drag was now put on the road, and the sand thus raised by ploughing was pulled from the shoulders upon the clay and thoroughly incorporated. The road was then smoothed and left for travel.

While the construction of this road followed closely the ordinary method of sand-clay construction, still there were some variations, owing to the peculiar conditions to be met, as has already been explained. It was believed that a surface was necessary which would resist the occasional heavy showers incident to this climate and at the same time the action of the winds. Therefore, the clay having the greatest tenacity was selected. Because of the dryness of the climate it was deemed best to proportion the clay far in excess of the sand. While the clays available may not be altogether desirable, still any clay that will pack under traffic will improve greatly the heavy sands found in this locality.

The cost data of this experiment follow, and also the miscellaneous details of all four sand-clay experiments (Table 6).

| | |
|---|---|
| Stripping clay in pit | $ 7 17 |
| Ploughing up clay in pit | 10 50 |
| Loading clay into wagons | 33 00 |
| Hauling clay to road | 39 50 |
| Spreading clay on road | 10 00 |
| Sanding, harrowing, and finishing road | 2 33 |
| Cost of clay on road per cubic yard | 40 |
| Cost per square yard of part clayed | 10 |
| Rate per mile | 707 45 |

**Table 6.—Miscellaneous Data of Sand-clay Experiments.**

| Place. | Length of road treated. Ft. | Entire Width of road. Ft. | Width of clayed part. Ft. | Depth of Clay layer. Ins. | Clay hauled to road. Cu. yds. | Surface clayed. Sq. yds. |
|---|---|---|---|---|---|---|
| Garden City | 765 | 30 | 12 | 9 | 256 | 1,020 |
| Dodge City. | 9,750 | 30 | 14 | all | 3,703 | 15,167 |
| Bucklin | 4,271 | 30 | 14 | 12 | 1,883 | 6,644 |
| Ford | 350 | 30 | 16 | 13 | 179 | 622 |

a Depth of clay and sand.

### Experiment at Dodge City, Kans.

The same natural conditions exist here as at Garden City, and the sand hills are on the same side of the river, though only two miles wide. A section of the road leading to Mineola, Kans., was selected, and after the work was started the citizens became much interested, and urged that the entire two miles be hard surfaced. This was done.

The general plan of construction at this place was similar to that at Garden City. A deposit of clay was found near the middle of the section to be improved, formed from silt from an old irrigation ditch no longer in use. The water had been allowed to run into a large basin, and about four acres were covered to a depth of 18 inches with this fine silt. It had thoroughly dried out, so that when ploughed up it was in excellent shape for handling with shovels. This material was almost gritless, and became very sticky when wet. Although this may be regarded as an unusual condition in this locality, nevertheless results may prove it expedient to use a river silt for road purposes in other irrigation districts when practicable. If this material had not been found the road would have cost fully 50 per cent. more.

The entire roadway was 30 feet wide. In the centre of this a 14-foot track for clay was laid out by ploughing two furrows 14 feet apart. The dirt was thrown out toward the side gutters. Beginning at the middle, the 14-foot part was ploughed by backfurrowing the dirt toward the centre. This formed a crown in the middle of the part to be clayed. Next, this was harrowed and the subgrade completed with a small grader. The shoulders were then made by running a furrow outside the subgrade and backing up the first furrow on each side. Two more such furrows were run, and in this way the shoulders were formed at least 10 inches higher than the subgrade. If the cross section is level, a toothed harrow is excellent to prepare the subgrade after it has been ploughed as has been described above. When it is necessary to move material from one side to the other, or to carry material along in the subgrade, a two-horse grader will be found useful.

After the subgrade had been prepared the clay was hauled and dropped three loads abreast. The centre loads followed the centre line exactly, and to this end a line of centre stakes was set 200 or 300 feet in advance of the clay hauling. It was then an easy matter to drop the side loads properly. It is best to keep the centre loads 30 to 50 feet in advance of the side loads. In this way three teams may be kept busy at the same time. In order to get a sufficient sand covering upon the road, drag scrapers were used and sand hauled from beyond the borders of the roadway. It was then spread with a harrow and a two-horse grader evenly over the road and mixed with the dust and fine particles of clay. After a rain the sand was quickly incorporated with the clay. Still more sand was evidently needed, and this was harrowed into the clay as the mass dried and packed under travel. Finally, a large grader was used to shape the road.

As has been stated above, the clay at this place was rather more of an accident than a natural condition of wide extent; still it is of sufficient importance to justify a careful study of its behaviour on the road. It would be an easy matter to provide settling basins along irrigation canals where this fine silt could be collected, and after the water had been shut off, the clay thus deposited could be hauled upon the road. In this way large quantities of material could be provided, and if its use proves as valuable as indications seem to show, much good may be expected from this source in the improvement of heavy sand roads along irrigation ditches. In this experiment the silt combined readily with the sand when wet and held it firmly. The addition of sand took away its sticky qualities.

The cost data of this experiment follow:—

| | |
|---|---|
| Foreman for job | $ 51 50 |
| Excavation (2,539 cubic yards) | 396 69 |
| Shaping subgrade | 70 00 |
| Ploughing up clay | 54.875 |
| Loading clay into wagons | 470 00 |
| Hauling clay to road | 608 38 |

| | |
|---|---|
| Spreading clay on road | 93 00 |
| Harrowing and mixing clay and sand | 6 00 |
| Sanding road and building shoulders | 107.685 |
| Dressing road with grader | 27 00 |
| Work on bridge, timber, etc | 59 53 |
| Repairs, water boy, and sundries | 52 75 |
| Cost per square yard of part clayed | .138 |
| Rate per mile | 1,135 83 |

**Experiment at Bucklin, Kans.**

For this experiment a portion of the road leading from Bucklin to Spearville was selected. It was on the south side of the Arkansas River, as in the preceding cases. The general plan of construction was identical with that used at Dodge City, but the clay was of a different quality. At the south end of the road a clay was used which proved to be a kind of buckshot. It hardened well, although the surface appeared to be of a loamy character and blistered badly at first, though later it packed and gave promise of durability. After removing the surface of the clay pit to a depth of 12 inches the character of the clay changed materially and it promised to be an excellent road material. At first it was feared that it might lack the necessary binding power, but as it was the only material within a mile of the road its use was begun as an experiment. When the pit was lowered 30 inches the clay became excellent in quality. This pit was located at the highest point on the road, and its use proved a great economy because of the ease of haul. From a place near the other end of the road an alkali clay was hauled upon the sand at that end. A section 6,771 feet long was laid out and ploughed and the subgrade shaped ready for the clay. Of this distance, a section 4,271 feet long was improved and a section of 2,500 feet left to be improved by the community.

Following are the cost data of this experiment:—

| | |
|---|---|
| Foreman for job | $ 50 00 |
| Excavation (1,584 cubic yards) | 224 07 |
| Shaping subgrade | 32 37 |
| Ploughing up clay in pit | 16 75 |
| Loading clay into wagons | 235 75 |
| Hauling clay to road | 304.875 |
| Spreading clay on road | 44.625 |
| Repairs, etc. | 40 92 |
| Cost per square yard of part clayed | .14 |
| Rate per mile | 1,183 64 |

**Experiment at Ford, Kans.**

At Ford a short section forming the south approach to the bridge crossing the Arkansas River was graded and clay added. This was really a matter of grading an incline to the bridge, but as the material for the approach was sand it was necessary to form a hard top surface. This was done by adding clay. The material was gotten from a valley basin where clay had settled. The section of road treated was 350 feet long, and a bed of clay 16 feet wide and about 12 inches deep was put on. The surface was then covered with sand two inches deep and left for traffic to mix. It was frozen hard when placed on the road.

Some of the cost details follow:—

| | |
|---|---|
| Filling up and widening road | $ 17 25 |
| Ploughing, loading, and hauling clay | 10 50 |
| Spreading clay | 8 00 |
| Sanding clay | 8 00 |
| Dressing road with grader | .50 |
| Total cost | $104 25 |

## TORONTO ENGINEERS' CLUB ANNUAL EXCURSION.

On Friday and Saturday, July 16th and 17th, the Engineers' Club, Toronto, held their annual excursion. Last year they journeyed from Toronto to Peterboro', and sailed up the Trent Valley Canal from Peterboro' to Bobcaygeon. This year they went by C.P.R. from Toronto to Bobcaygeon, and sailed west through sixty-eight miles of lake, river and canal to Lake Simcoe, then across Lake Simcoe from Beaverton to Jackson's Point, and home to Toronto by the York Radial Railway.

The members of the club who were along, together with a few friends, were: C. H. Rust, City Engineer; J. G. Sing, Government engineer, both of whom are past presidents of the club; John Tolmie, M.P., J. H. McGregor, C. J. Printz, W. A. Johnson, John Scott, W. G. Bligh, E. A. Collyer, E. A. James; A. T. Malone, resident engineer, Newmarket Canal; O. N. Scott, J. A. Richardson, W. A. Bucke, B. G. McBurney, T. C. Irving, jr., R. Home Smith, C. B. Hamilton, A. F. McCallum, W. C. Brennan, R. A. Baldwin, chairman Executive; T. L. Somerville, D. D. James, C. W. Dill, E. H. Keating, T. J. McConkey, R. Southam, J. S. Fielding, and L. J. Street, the treasurer of the club, and who capably managed the expedition.

On the boat the party were the guests of Mr. M. J. Butler, Deputy Minister of Railways and Canals, and in the hands of Mr. J. Harris McClellan, superintendent Trent Valley Canal, who was not only an ideal host, but a veritable cyclopedia of information as well.

The trip was really the second chapter of last year's outing, which was over the eastern end of the canal. The day was spent aboard, with intervals for examining the engineering works along the route.

The expressions of approval were very general among the visitors at finding the work done along the whole route of so substantial and permanent a character. The new steel lift locks at Kirkfield naturally drew the closest attention, and the ease and precision with which these immense steel tanks lowered the boat from the level of Balsam Lake, the highest of the system, to the reach forty-eight feet below, as well as the massive and finely-finished character of the whole lockage work, was the subject of much favorable comment.

Boats can now travel on the canal from Lake Simcoe to Healy's Falls, a distance of 165 miles. Between Simcoe and the high level at Balsam the rise is 122 feet, this being overcome by six locks, one of eleven feet, three of fourteen feet each, one of twenty-two feet, and the Kirkton lift of forty-eight feet. There will be eight feet and four inches of water over the sill, and the locks will accommodate vessels 140 feet long by 34 feet beams. A barge this size will hold 25,000 bushels of grain. The total length from Lake Simcoe to Trenton will be 210 miles, or, when the Severn works are completed from Georgian Bay to Trenton, it will be 272 miles. The supplementary canal from Cooke's Bay on Lake Simcoe to Newmarket is 17½ miles in length. On the main canal there are great contributory lake and river waters, which are controlled by dams and weirs, while there is a drainage area of over one hundred square miles contributory to the Newmarket system, over which the water can easily be controlled, thus assuring abundance of water for operating at all times of the year, and furnishing as well very large quantities of valuable water power.

Before parting, Mr. Rust, on behalf of the club, expressed to Mr. McClellan their appreciation of the most hospitable entertainment provided. They were delighted to see the country and the work that was being done. In his reply Mr. McClellan spoke of the scope of the work and the good progress that was being made, especially since the Deputy Minister, Mr. Butler, had taken it in charge. He hoped to see it opened all the way from Midland to the Thousand Islands. In New Jersey alone, he said, there were $50,000,000 spent annually in the tourist trade, and the large and increasing tourist traffic in the waters served by this canal would soon make this alone a very important source of revenue, in addition to the local and through commodity trade. The character of the work showed for itself, and he was delighted to have the Toronto engineers with him to inspect it.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**National Irrigation Congress.**—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

**League of American Municipalities.**—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé, R.S.A.; P.O. Box 259, Montreal, Que.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Nova Scotia.**

HALIFAX.—Tenders for supplying furnishings for the Nova Scotia Technical College will be received up to Saturday, July 31. F. W. Smith, secretary to commissioner.

SYDNEY.—Tenders are wanted until August 4th, for sewer extensions. D. McD. Campbell, City Engineer.

**Quebec.**

MONTREAL.—Tenders will be received until Thursday, the 29th July, for the supply of: (1) A ten ton steam road roller. (2) 1,600 tons of ¼-inch "Banc-Rouge" gravel (screenings). (3) 900 tons of 2-inch "Banc-Rouge" broken stone. L. O. David, City Clerk.

**Ontario.**

BERLIN.—Tenders are invited for bitulithic, asphalt block, and vitrified brick pavements. Davis and Johnson, City Engineers.

LONDON.—Tenders will be received up to Saturday, July 24th, for construction of the Scanlon drain, London East. F. W. Farncomb, Township Engineer.

MIDLAND.—Tenders will be received up to Monday, the 26th July, for the construction of approximately 20,000 lineal feet of concrete walks. Thos. I. Trueman, Town Clerk.

OTTAWA.—Tenders will be received up to August 15 for the furnishing of iron posts for use on the survey of Dominion lands. P. G. Keyes, secretary, Department of the Interior.

OTTAWA.—Tenders will be received up to August 15th, for supplying the lubricating oils required by the Department of Marine and Fisheries for three years. G. J. Desbarats, acting Deputy-Minister of Marine and Fisheries.

OSHAWA.—Tenders wanted until Aug. 2 for supplying material and erecting a Y.M.C.A. building in Oshawa. Plans and specifications may be seen at Mr. F. Bull's office, Oshawa, or at the office of C. J. Gibson, 75 Yonge Street, Toronto.

RAINY RIVER.—Tenders will be received until July 28th for pipelaying, pumping machinery and other waterworks equipment. Jas. A. Bell, Consulting Engineer, St. Thomas, Ont. J. H. Wilson, Town Clerk. (Advertised in The Canadian Engineer.)

SIMCOE.—Tenders for Post-Office fittings will be received until July 30th. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received up to Tuesday, August 3rd, for the construction of reinforced concrete arch of 35-foot span, having a 42-foot roadway, and two 6-foot sidewalks, containing about 1,500 cubic yards of concrete. Joseph Oliver (Mayor), Chairman Board of Control.

TORONTO.—Tenders will be received until July 28th for the construction of transformer and interswitching stations at Toronto and other points in Ontario. Hydro-Electric Power Commission, Continental Life Building.

**Manitoba.**

WINNIPEG.—Tenders will be received until August 2nd and August 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chace, engineers, Winnipeg; William Kennedy, jr., Y. M. C. A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

WINNIPEG.—Tenders for supply of quantity of brass and galvanized fittings will be received to Saturday, July 24th. M. Peterson, Secretary, Board of Control.

**Saskatchewan.**

FRANCIS.—Tenders will be received until Monday, July 26th for: (a) Furnishing material and constructing a concrete collecting basin, 25 ft. x 25 ft. x 18 ft. (b) Furnishing 9,750 feet 6-inch wooden pipe. (c) Furnishing 4,630 feet 6-inch cast-iron pipe, with necessary special castings. (d) Gate valves, valve boxes and soft lead. (e) Labor laying wooden and iron pipe. C. R. Gough, Secretary-treasurer.

MOOSE JAW.—Tenders will be received until Monday, August 9th, for the construction of a reinforced concrete bridge and abutments. J. Darlington Whitmore, City Engineer. (Advertized in the Canadian Engineer.)

MOOSE JAW.—Tenders will be received until August 9th, for the construction of concrete walks and concrete block crossings. J. Darlington Whitmore, City Engineer. (Advertized in the Canadian Engineer.)

SASKATOON.—Tenders are wanted for the construction of a subway under the C.N.R. tracks. Geo. T. Clark, City Engineer.

**British Columbia.**

KAMLOOPS.—This city desires tenders for pipe, hydrants and fittings in connection with waterworks extensions. R. H. Lee, City Engineer.

NEW WESTMINSTER.—Tenders will be received up to Monday, August 9th, for supplying about 74,600 feet of steel pipe, with an inside diameter of 24 inches, and about 16,000 feet of steel pipe with an inside diameter of 12 inches. Specifications may be seen at the office of Messrs. Hermon and Burwell, Vancouver, B.C. W. A. Duncan, City Clerk.

## CONTRACTS AWARDED.

**Quebec.**

WESTMOUNT.—Cairnie & Company have secured a contract from this city for laying sidewalks and channels at 25 cents a square foot. Gutters and channels will be constructed by Morssen & Company at 69 cents a square foot, and gutters only at 52½ cents. The acceptance of the Structural Steel Company's offer of $3,800 for incinerator extensions was ratified.

**Ontario.**

AMHERSTBURG.—The Gutta Percha & Rubber Company have been given a contract by this municipality for 300 feet of No. 1 Paragon hose. The town has been buying this brand for many years with satisfactory results.

LONDON.—At a recent council meeting the following contracts for sewers were awarded: Hamilton road, F. Harding, $499, side drains 28 cents a foot; Palace Street, F. Harding, $524, side drains 26 cents; Ardavan Place, Blight & Fielder, $623, side drains 50 cents.

PETERBOROUGH.—James Peat & Sons, of Petrolia, Ont., have received a contract to bore for gas and oil at $1.50 per foot for 2,500 feet.

TORONTO.—The Provincial Department of Public Works has awarded the contract for the construction of the new dam at Dog Lake to Mr. Wm. White, of Burlington.

TORONTO.—The contract for the new boilers for the Normal School heating plant has been awarded to the Polson Iron Works, Toronto, at $1,895. The Institute for the Blind at Brantford is also getting a new set installed, for which the Waterous Engine Works Company, of Brantford, will receive $1,940.

**Saskatchewan.**

NORTH BATTLEFORD.—One hundred thousand dollars will be spent by this municipality for the installation of waterworks, sewerage and electric light. Contracts have been awarded as follows:—Excavations, McManus & Marocco, of Winnipeg; power house and pump house, William Cook, Saskatoon, Sask.; steel water tower and housing, Ontario Wind Engine & Pump Company; foundation for water tower, William Cook; water pipes (cast iron and special); hydrants, valves, etc., Canada Foundry Company.

**Alberta.**

EDMONTON.—The Edmonton Standard Coal Company has been given a contract for 1,400 tons of coal at $2.90.

EDMONTON.—Tenders for the new high school were as follows:—

| | Roman stone. | Calgary. | Tyndall. |
|---|---|---|---|
| *Carmel & Spencer ..... | $105,101 | $105,101 | $115,601 |
| Manson & Dunlop ..... | 113,690 | 114,494 | 117,799 |
| Rendall & Mackay .... | 114,578 | 115,578 | ..... |
| McHardy & Sheppard .... | ..... | ..... | 135,377 |
| Geo. C. Porter ..... | 117,184 | ..... | 119,684 |
| Chas. May ..... | 116,400 | 116,980 | ..... |
| Pheasey & Batson .... | 114,300 | 114,800 | ..... |

*Accepted.

## RAILWAYS—STEAM AND ELECTRIC.

**New Brunswick.**

MONCTON.—The new I.C.R. freight car and passenger car repair shops, to be built at St. John, will be of the most modern and advanced style, according to the plans now on file at the chief engineer's office of the I.C.R. here.

ST. JOHN.—The C.P.R. will spend $75,000 on improvements at Aroostook Junction. Tenders for the extensions, which include a six-stall engine house, turntable and pit, will be opened in a few days.

ST. JOHN.—A. & W. D. Wheaton have been awarded the contract by the Drummonds for the twelve mile section of railroad between Bathurst and their mines in Gloucester County. They have sublet five miles of the work to the contracting firm of Mitchell & Sutherland. Both of these firms have been subcontractors from the Toronto Construction Company on their work on the G.T.P. Mitchell and Sutherland were at Chipman, and the Wheatons about eight miles northeast of Stanley in York County.

**Quebec.**

MONTREAL.—Most of the proceeds of the sale by the Canadian Pacific of $5,000,000 of its preferred stock in London will be applied to the enlargement of its terminal facilities at Montreal.

MONTREAL.—A strong belief prevails in railway and financial circles that negotiations are now in an advanced stage aiming at the acquisition of the New York Ontario and Western, either by the Canadian Pacific direct or through its Soo line. The assets of the New York, Ontario and Eastern are valued at $92,870,000, of which $77,000,000 represents franchises and property and $12,000,000 investments in other companies. Its common stock is $58,000,000, and its funded debt $23,000,000.

**Ontario.**

COBALT.—Chief Engineer C. G. Henry, of the Nipissing Central Railway, has gone to Ottawa to file with the Government and Railway Commission, final location and structural plans of the Nipissing Central Railway, which is to connect Cobalt and Haileybury by an electric line this year.

FORT WILLIAM.—A new union depot is being built at this point. The C.P.R. has put a force of men on the excavations.

HAMILTON.—It is believed that railway construction will be active about this city during the latter part of this year, as several railway companies are likely to begin operations in extending their lines. The Radial may be extended from Oakville to Toronto, the Guelph Junction spur line will probably be started, the Canadian Northern proposes to build its Niagara to Ottawa line, and the Hamilton, Waterloo & Guelph Railway will likely be started. The condition of the money market during the last year or more has interfered with the plans of some of the companies mentioned, but it is understood that this difficulty has been or is being met and that in a short time active operations will be commenced.

OTTAWA. — The Railway Commission has issued an order compelling every railway in Canada to have the whole of its right-of-way properly fenced in by January 1, 1911. The order states that the fence must be of a minimum height of four feet six inches, and gates must be provided at every farm crossing. At every level highway crossing there must be adequate cattle guards. The width of approaches to level crossings must be twenty feet on concession and main roads and sixteen feet on side and bush roads.

TORONTO.—The Canadian Northern Railway have just sold debentures amounting to $10,000,000, which will be applied on the construction of a line from Toronto to Niagara Falls, with an extension from Toronto to Smith Falls and Ottawa, to join existing lines to Montreal and Quebec via Hawkesbury.

TORONTO.—Writing to the Ontario Railway Board, the manager of the Irondale Bancroft and Ottawa Railway intimated that his line might shortly be extended in the near future towards Ottawa. At present the line extends from Kinmount Junction on the Grand Trunk to Bancroft, a distance of 48 miles.

**Manitoba.**

WINNIPEG.—The Fisher Construction Company, of Chicago, is considering the construction of an electric railway from Minot, N.D., to a point near Boscurnis, Sask. It is said that $150,000 has already been subscribed.

**Saskatchewan.**

NORTH BATTLEFORD.—Operations on the North Battleford-Athabasca line to the North-West began on Monday last. One of the construction parties arrived here on Sunday, followed on Thursday by a second party. Fifty miles of this road has been guaranteed by the Government, but it is probable that considerably more than fifty miles of this road will be built this year.

**Alberta.**

CALGARY.—Medium weight rails are being replaced by those of the heaviest weight on the Edmonton and Macleod branches of the C.P.R.

EDMONTON.—An eighteen-stall roundhouse and work shops will shortly be erected in Edmonton by the G.T.P.

EDMONTON.—Messrs. Foley, Welch and Stewart have received the contract for building that part of the Grand Trunk Pacific between Macleod River and Tete Juane Cache, B.C., which will carry the line through and fifty miles to the west of the Yellowhead Pass. This section is one hundred and eighty miles long. Rails are being laid from Edmonton west to MacLeod River, to which point, it is announced, trains will be running from Winnipeg by September. The railway company is also calling for tenders to be in by August 15th, for the construction of 140 miles of line from Kitsalas Canyon to Aldermere in Buckley Valley, being the second section inland from the Pacific Coast end of the line. With construction under these contracts in operation, there will be left but one section of 350 miles of gap in northern British Columbia.

**British Columbia.**

HEDLEY.—Construction of the V. V. & E. is being rushed as rapidly as possible. D. Stewart has the contract for track-laying.

KAMLOOPS.—The Canadian Northern surveying parties engaged in locating a line between Kamloops and Vancouver, have now reached Spuzzum. The bluff opposite Yale calls for a tunnel 2,000 feet in length.

PHOENIX.—A party of C.P.R. engineers recently made a survey of a proposed track 12 miles in length, from Phoenix to Wellington camp.

VANCOUVER.—The British Columbia Electric Railway have started laying the rails on the Hastings Street extension The rails are already down as far east as Park Drive, and the work is being rushed.

VANCOUVER.—Considerable work is being done by the Canadian Pacific in the Boundary country improving their track and replacing a number of wooden bridges with concrete and steel structures. Two of these a few miles from Nelson, B.C., are now being completed, and will each be five hundred feet long with five spans, the centre span being 130 feet wide. During the past three years fifty-four old wooden bridges have been replaced either by steel structures or by filling in ravines. Last year over 4,000 feet of wooden bridges were thus superseded, and it is expected that as much work will be done this season.

**Foreign.**

BOSTON (MASS.).—The Boston and Maine Railway has ordered 21,000 tons of rails.

MINNEAPOLIS (MINN.).—M. D. Rhame, division engineer of the St. Paul road, has prepared plans for the elevation of the tracks of the company in Minneapolis. They provide for the elimination of the grade crossing and would involve an expenditure of approximately $6,000,000. This cost it is estimated, would be $2,000,000 less than to depress the tracks. It would require two years to do the work.

## CEMENT—CONCRETE.

**Ontario.**

ERIEAU.—Concrete will be used in the erection of a school here. J. L. Wilson & Son, of Chatham, are architects.

GUELPH.—Mr. C. H. Conery, of Guelph, has secured contracts for four new cement bridges. One is at Georgetown, another is in Nelson Township, while a third will be erected in Esquessing.

LONDON.—The city clerk gives notice of the city's intention to construct many local improvement works, including numerous cement sidewalks, curb and gutters.

**Saskatchewan.**

MOOSE JAW.—Elsewhere in this issue appears an invitation from J. Darlington Whitmore, City Engineer of Moose Jaw, for tenders on the construction of a reinforced concrete bridge and abutments.

MOOSE JAW.—The city engineer, Mr. J. Darlington Whitmore, desires tenders for the construction of concrete walks and creosote block crossings. Further particulars are given in our advertising pages.

NORTH BATTLEFORD.—This municipality will spend ten thousand dollars on concrete sidewalks.

WEYBURN.—Mr. Willis Chipman, C.E., of Toronto, has charge of the construction of a water power here, the foundation of which will require 500 barrels of cement. Tenders closed yesterday.

YORKTON.—Snyder Bros., of Portage la Prairie, have a contract for the erection of a building for the "Enterprise," in which concrete will be used.

## FINANCING PUBLIC WORKS.

**Quebec.**

MONTREAL.—Longueuil Council is considering by-laws for the construction of concrete sidewalks and for building a street railway.

**Ontario.**

BROCKVILLE.—On August 5th the ratepayers will vote upon a by-law to raise $16,000 for rebuilding six bridges.

NEW HAMBURG.—The by-law voted upon in Wellesley township to take $15,000 stock in the People's Electric Railway was carried by 172 majority.

NORTH TORONTO.—The ratepayers have passed by-laws for a sewerage system and parallel roads. Mr. T. Aird Murray, of Toronto, prepared the plans for the sewerage system.

**Saskatchewan.**

SASKATOON.—The ratepayers will shortly vote on a by-law to raise $20,000 to assist the Northwestern Telephone Co., Limited.

SASKATOON.—The following by-laws have been given readings: Concrete bridge, $10,000; concrete walks, $19,000; electric light plant extensions, $35,000.

**British Columbia.**

KAMLOOPS.—The ratepayers here recently carried a by-law to raise $20,000 for waterworks.

## SEWERAGE AND WATERWORKS.

**New Brunswick.**

MONCTON.—The new city pumping station and foundation for the pumps are completed and ready for the electric turbo pump to be installed. Operations have been commenced for the extension of the power house to accommodate the new boiler, engine and generator.

**Ontario.**

COBALT.—Messrs. Galt & Smith, of Toronto, have prepared plans for a sewerage system for this town.

LONDON.—For $48,000, J. H. McGregor, has offered to furnish two million gallons of water to city, with air lift and pumping plant of four million capacity.

PETERBOROUGH.—Work on the new waterworks dam, which is being constructed by the Bishop Construction Company, is progressing favorably.

TORONTO.—A special meeting of the Provincial Board of Health was held at the Parliament Buildings on Wednesday to consider the plans for a sewage disposal and waterworks system for the towns of Cobalt and Rainy River.

**Saskatchewan.**

WEYBURN.—Waterworks are being installed here by Murphy Bros.

**British Columbia.**

KAMLOOPS.—Mr. H. K. Dutcher, consulting engineer, of Vancouver, recently made a report on the possibilities of extending the water system in this city. The council decided to purchase a condenser at a cost of $1,400.

NEW WESTMINSTER.—At a recent meeting of the City Council Messrs. Hermon & Burwell, consulting engineers, Vancouver, submitted a report and estimate for the 24-inch supply main from Coquitlam Lake to Queen's Park reservoir, and a 12-inch supply main from the reservoir to the city boundary on Lulu Island. Clearing, grubbing, culverts and trestles, excavating trench and back filling 74,000 feet, pipe laying and steel pipe delivered along trench, gate valves, air valves and special bends, the engineers estimated to cost $325,000. This includes the delivery of the water to Queen's Park reservoir, while to supply 16,000 feet of steel pipe, laying, and placing a submerged pipe across North Arm of the Fraser River, with gate valves, etc., to serve Richmond municipality, they estimated the cost of $35,000. Contingencies, engineering, and inspection at five per cent. was figured at $18,000, or a total cost for the system of $378,000. Tenders for supplying the pipe are called for until August 9th.

PRINCE RUPERT.—The British Columbia Government have agreed to provide waterworks and sewerage systems and streets for this city.

VANCOUVER.—During the quarter ended June 30th nearly 12 miles of new water mains have been laid in Vancouver.

## LIGHT, HEAT, AND POWER.

**Ontario.**

TORONTO.—The members of the Hydro-Electric Commission, together with the heads of the engineering staff, returned to Toronto a few days ago, after completing a tour

of inspection of the right-of-way for the new Government power line. The Hon. Adam Beck informed the press that the progress made was satisfactory. Eighty per cent. of the easements for the towers had been secured, 6,000 telephone poles distributed and eight miles of the line erected. Seventy towers are in the field ready for erection, and the contractors are now ready to deliver 70 more each week until their contract has been filled. Tenders for the erection of the remaining ten transformer stations will be received next week.

TORONTO.—The Ontario Government has cancelled the lease held by the Northumberland-Durham Power Company for the development of power at Healey's Falls, on the Trent River. The Government claims the company has delayed commencing operations and refuses to have the franchise tied up any longer.

**Manitoba.**

WINNIPEG.—In connection with the transmission line the clearing is well ahead of construction and almost completed upon the accessible right-of-way. The tower footings are being placed in the neighborhood of Tyndall. Road-making and ditching are being pushed. About 20 miles of the telephone line have been completed. The bulk of the ballasting on the tramway has been finished and staking out of towers is completed between Brokenhead River and Bird's Hill. Smith, Kerry & Chace have charge of the work.

## CURRENT NEWS.

**New Brunswick.**

FREDERICTON.—Contractor Low's men have about completed work on the retaining wall and the concrete curbing and gutter on the approach to the highway bridge on Carleton Street. The work has been done for the Provincial Government under the direction of Chief Engineer Wetmore and City Engineer Grimmer.

**Ontario.**

SAULT STE. MARIE.—At 5 a.m., on July 12th, the steamer John B. Cowle, of the United States Transportation Company, downbound, loaded with 8,000 tons of iron ore, while passing Whitefish Point in Lake Superior, was struck amidships by the steamer Isaac M. Scott, upbound on her maiden trip. The Cowle was almost cut in two and sank in three minutes in forty fathoms of water, drowning thirteen of her crew. The Scott had a large hole cut in her starboard bow above water, but was able to reach the Soo in safety. The Cowle was a steel vessel, 400 feet long by 50 feet beam and of 3,911 tons net. She was built in 1902.

TORONTO.—The City Council, with only one dissentient, recently agreed to sell for $35,000 to the National Iron Works, Limited, of which Cawthra Mulock is the head, 5½ acres of land and 16½ acres water lot. The company undertakes to erect $100,000 worth of buildings within one year. A big iron smelting steel and ore reducing works will be erected on the site.

## MISCELLANEOUS.

**New Brunswick.**

ST. JOHN.—A scheme, said to be new, is to be tried in St. John in connection with street paving. Asphalt is to be laid on top of wooden paving blocks.

**Quebec.**

MONTREAL.—It is announced that the C.P.R. has completed plans for an elevator at Victoria Harbor, having a storage capacity of twelve million bushels, which would make it the largest elevator in the world.

SHERBROOKE.—The new building which is being erected by MacKinnon, Holmes & Company, is nearing completion. About the middle of August, the company will commence operations. They will do plate and structural work of every description, including bridges, buildings, towers, coal and ore handling apparatus, apparatus for the loading and unloading of cars, tanks, boilers, etc., and will carry in stock a large quantity of steel plates and structural shapes. Mr. Holmes, one of the members of the company, and a noted structural steel engineer from Philadelphia expects to be in Sherbrooke next week to remain permanently; while Mr. MacKinnon has been a resident of this city for some years past, having been assistant to the general manager of the Jenckes Machine Company. Both are members of the Canadian Society of Civil Engineers.

**Ontario.**

GUELPH.—Fourteen thousand square yards of Westrumite pavement are to be laid on Upper Woolwich Street by the city of Guelph.

OTTAWA.—A by-law will probably be submitted to ratepayers at an early date with a view to the establishment of an incinerator plant.

TORONTO.—At a meeting of the York Township Council, on Tuesday, Engineer Barber submitted his report and estimates for the improving of Bathurst Street between St. Clair and Eglinton Avenues. He estimates the total cost at $12,060.

**Manitoba.**

BRANDON.—City Engineer Speakman recently prepared an estimate of the cost of projected road improvements and an issue of debentures amounting to $12,000 will probably be authorized.

**British Columbia.**

VANCOUVER.—The question of establishing an incinerator upon a central site is being discussed by the City Council here.

## TELEPHONY.

**Ontario.**

BROCKVILLE.—At a meeting of representatives of the seven rural telephone lines in Leeds and Grenville Counties it was decided to form a federation, with an exchange in the village of Athens.

TORONTO.—Telephone companies have been incorporated at Hawkestone, Ont., and Easton's Corners, Ont. R. W. Metcalfe is interested in the Oro Telephone Company at Hawkestone, while W. H. Watts is a provisional director of the Walford Rural Telephone Company at Easton's Corners.

**Saskatchewan.**

REGINA.—The Government recently awarded the contract for the completion of the long distance telephone line from Saskatoon to Prince Albert to J. S. Bartleman, of Regina. The line is to be completed this fall. Work on the Arcola branch long distance telephone has progressed from the Manitoba boundary as far as Fillmore, and the line is now in actual operation from the boundary to Forget.

## PERSONAL.

MESSRS. HARRY A. MOORE and JOHN J. SCOLLAN, electrical and mechanical engineers, have opened offices in Toronto at 43 King Street West.

MR. T. T. SHERWELL, Jr., of the firm of Drummond-McCall & Company, Montreal, sailed last week for England.

MR. FREDERICK FETHERSTONHAUGH, of Fetherstonhaugh & Company, patent barristers, Toronto, has been engaged by the Ontario Government to prepare a report in connection with the alleged patent infringement claimed by the Cameron Septic Tank Company.

PROFESSOR A. R. GREIG, of the Mechanical and Engineering Department of the Manitoba Agricultural College, has accepted a position on the staff of the University of Saskatchewan, as Professor of farm mechanic and rural engineering, in the Saskatchewan College of Agriculture. Professor Greig will have from the outset, direct superintendence of all

constructed work in connection with the erection of the college buildings at Saskatoon, plans and specifications for which are already being made by the university architects in Montreal.

MR. A. W. CAMPBELL, Deputy Minister of Public Works in Ontario, has returned home from Seattle, where he attended a good roads convention.

MR. GORDON GRANT, inspecting engineer of the Transcontinental Railway Commission staff, has accepted the position of chief engineer of the Eastern Division of the system.

MR. ROBERT W. GRACE, general superintendent of the Canada Foundry, Toronto, Ont., has resigned to accept the position of general superintendent of The Clatt Iron Works Company, of Dayton, Ohio.

## LATE TENDER.

TORONTO.—Tenders will be received until July 27th for the construction of asphalt and vitrified block pavements, concrete curbs and concrete walks. Joseph Oliver (Mayor), Chairman, Board of Control.

## OBITUARY.

MR. LEFFERT LEFFERTS BUCK, one of the best known civil engineers in America, who was associated with Roebling in the building of the Brooklyn bridge, was chief engineer of the Williamsburg bridge across the East River, designed two steel arches across the Niagara River from the United States to Canada, and had direction of many other engineering works of note, died at his home at Hastings-on-the-Hudson on Saturday, July 17, at the age of 72.

## RAILROAD ORDERS.

(Continued from Page 103.)

7503—July 9—Authorizing the Canadian Northern Ontario Railway to construct a steel bridge over Rideau River near Ottawa at mileage 56.9 west of Hawkesbury, Ont.

7504—July 9—Authorizing the C.P.R. to construct Bridge No. 40.8, branch of Elk River, Cranbrook section.

7505—July 12—Authorizing the C.P.R. to construct its standard No. 6 station at mileage 25.7, Township Ekfrid, Ont.

7506—July 10th—Authorizing Vancouver, Victoria and Eastern Railway and Navigation Co. to divert portions of Riverside Avenue, Vermillion Avenue, Hoy Street and Surrey Street, and the lanes in Blocks 27 and 33, Princeton, B.C., to construct its railway upon, along and across Bridge Street and Vermillion Avenue, and occupy with its railway those portions of Riverside Avenue, Surrey Street and Hoy Street so closed up.

7507—July 9—Authorizing the G.T.R. to construct two additional railway tracks along and across Geddes Street, Clifford, Ont.

7508—July 9—Authorizing the town of Midland, Ont., to lay and maintain a drain pipe under lands and track of G.T.R. east of Victoria Street.

7509—July 9—Authorizing the Bell Telephone Co. to carry wires across tracks of the Toronto, Hamilton and Buffalo Railway at public crossing 1½ miles west of Fenwick Station, Ont.

7510—July 12—Authorizing J. A. Lake, Jackson's Point, Ont., to erect telephone wires across track of G.T.R. at Jackson's Point, Sutton, Ont.

7511 to 7513—July 9—Authorizing the Bell Telephone Co. to erect wires across tracks of Michigan Central Railway at: (1) Just east of Erie Street, Leamington, Ont. (2) At public crossing, Talbot Street, Leamington, Ont. (3) At public crossing, Erie Street, Leamington, Ont.

7514 to 7517—July 9—Authorizing the Norfolk County Telephone Co. to erect wires across tracks of G.T.R. at Lots 6 and 7, Con. 3; between Cons. 2 and 3, Lot 7; between Cons. 3 and 4; between Lots 3 and 4, Con. 4, in the Township of Woodhouse, Ont.

## PATENTS.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 103 Bay Street, Toronto, from whom further particulars may be obtained:—

Wm. J. Clifford, Paper Bag Holder; The Toronto Type Foundry Company, Limited, Assembling Mechanism of Typographical Composing Machines; N. S. Friderichsen, Machine for Casting Lead Seals; Thos. D. Kelly, Manufacture of Concrete for Roads; W. H. Emery, Sewing Machines; S. Z. de Ferranti, Process of Electric Welding; S. Z. de Ferranti, Electric Welding Machine.

## MARKET CONDITIONS.

Toronto, July 22nd, 1909.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. The spring rush is over and business steady.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, which is an indication of the state of the wholesale market, a price heretofore unheard of. The over-supply continues. Smaller dealers report a fair movement in small lots at $1.40 to $1.50 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.50, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—Unchanged and quiet at $13.85 to $14.05 per 100 lbs. Speculative handling put it down a trifle, but it recovered as above.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is rather weaker, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—Considerable demand for both Southern and Canadian dimension pine continues; hemlock dull. Prices are rather stiff all along the line. Dressing pine quotes $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar quotes $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—In moderate request at prices per catalogue. It is impracticable to quote figures, so great is the variety of this kind of goods, but prices are steady.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 4 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Not much moving; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1½ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—Prices steady and demand good. The price continues at 31c. to 31½c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

### CAMP SUPPLIES.

**Sugar.**—Granulated, $4.70 per 100 lbs. in barrels; Acadia, $4.60; yellow, $4.30; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Teas.**—Japans, 18 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

**Canned Goods**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.80 to $1.85; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Dried Fruits.**—Raisins, Valencia, new, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, 7½ to 9c.; fancy, 11 to 12c.; extra fancy, 14½ to 15c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ½c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 7½c.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Eggs.**—New laid, 22c. per dozen, in case lots.

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Cheese.**—Old cheese, 15c. for large; 15½c. for twins; new cheese, large, 12½c.; twins, 13c.

**Lard.**—Tierces, 14½c.; tub, 14½c.; pails, 15c.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Potatoes.**—Ontario, old, 75 to 90c. per bag in car lots on track.

* * * *

Montreal, July 22nd, 1909.

The past week has been a very quiet one in the pig-iron markets, practically no price changes taking place. Throughout the United States, however, the tone of the markets was firm and the demand, although not specially active, was all that could be expected. In fact, the situation in the United States is one of the bright spots in the markets of the world, the recent activity in the purchasing of material for railway equipment, coupled with the enquiry for prices of still further supplies of a similar nature, being of a most satisfactory nature. On the whole, if present anticipations are only realized there will shortly be small cause for complaint on the other side of the international boundary.

In Great Britain, however, the situation shows exceeding'y little improvement, although it cannot be denied that the general feeling, at the moment, is somewhat better. Actual business passing, however, shows very little alteration in volume. The export demand from Germany and the Continent is still light, and the recent slight improvement seems of but a temporary character. Prices, on the whole, hold about steady. An advance was recent'y quoted, but was followed by a slight decline, once more, so that little progress towards higher levels is made.

In Canada, reports are mostly of a very encouraging nature. Demand from all sources is all that the trade can look for, particularly in view of the less encouraging news from other quarters. The probability of a larger crop of coarse grains in the West, and of at least as large a wheat crop as a year ago, is a strong factor, and is making for permanency in the somewhat improved demand for iron. As to finished and semi-finished lines, no changes have taken place in prices, and but little in demand, quotations being as follows:—

THE QUALITY OTHERS STRIVE TO EQUAL

"QUEEN'S HEAD" Galvanized Iron

But be sure you get it.

CANADA

John Lysaght, Ltd. Makers, Bristol

A. C. Leslie & Co. Ltd. Montreal

8

**Antimony.**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.90 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3 1-2-inch, 14¾c.; 4-inch, 19c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 13¾ to 14c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1. Electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 15c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The nutlonk is steady. The following prices are for carload quantities and over, on dock, Montreal: No. 1 Summerlee, $19.50; selected Summerlee, $19 to $19.50; Clarence, $17; Midland or Hamilton pig is quoted at $19.50 to $20, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50; Carron soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $22 to $25. Spruce, 1-in. by 4-in. and up, $16 to $18 per 1,000 ft.; mill culls, $14 to $16. Hemlock, log run, culls out, $14 to $16. Railway Ties; Standard Railway ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—The market is steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized: ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ¼, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16,

# The Canadian Engineer

WEEKLY

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## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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**NOTICE TO ADVERTISERS**

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TORONTO, CANADA, AUGUST 6, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

### SINKING SHAFTS IN SANDY SOIL.

To overcome the difficulties of timbering and boring in sandy soil a novel process has been adopted recently in France.

The scheme is to solidify the sand around the bore-hole by converting it into a concrete. This not only keeps out water, but also prevents cave-ins.

The work is carried on as follows: A hole is bored, say, to thirty feet. In the hole a tube is dropped. The tube is perforated at the bottom, and through these perforations a cement grout is forced. The cement entering the sand forms a concrete, and thus a firm mass in which future operations may be carried on. An area of the required dimensions is operated over in this way, and then the boring is carried to a lower level until the proper depth is reached.

### WESTERN CANADA IRRIGATION CONVENTION.

This week there is meeting in Lethbridge, Alta., the Western Canada Irrigation Convention. Each year this young organization shows more strength and activity. Each season we see larger areas added to the irrigated belt, and each convention adds to the knowledge of the engineer engaged in this work.

The Association is becoming national in importance and influence, and they have among the membership the leaders in this work in Canada. Prof. H. W. Campbell, of Lincoln, Neb., will be one of the speakers at this convention.

### THE CEMENT MERGER.

The "cement merger" which was announced in the daily press does not yet appear to be a reality, nor do we expect to see a merger formed of the producing cement plants of Canada.

Consolidation of several companies may take place, and it is a fact that application has been made for a charter for the Canadian Consolidated Cement Company, capitalized at $25,000,000. The outcome of the present campaign will be watched with great interest.

### WATER CONSUMPTION.

Montreal, Que., is a city of about 345,000, and for the past few days the daily water consumption has risen to over 42,000,000 gallons, or nearly 120 gallons per capita per day. One day during July the consumption was 43,427,590 gallons. Every tap in Montreal must have been working overtime.

The water used for seven days, from July 22nd to July 28th, was as follows: July 22nd, 42,930,930 gallons; July 23rd, 40,562,190 gallons; July 24th, 41,165,785 gallons; July 25th, 37,141,935 gallons; July 26th, 38,422,480 gallons; July 27th, 41,697,580 gallons; July 28th, 42,525,615 gallons.

This is an average increase of two millions a day over the consumption of a year ago.

Plenty of good water is a necessity, but there must be a large leakage and waste when the consumption rises so high per capita as in Montreal.

To prevent waste appears well nigh impossible, but regulation by meter would make those who cause the waste pay the bill.

## THE RAILWAY EARNINGS.

The railway earnings for the past month and past year show a decided improvement over similar periods a year ago. Every road reports an increase in business and profits. A splendid barometer of the business in the world of affairs is the railway earnings.

As might be expected, the number of idle cars is growing rapidly less, and shortly we may hear the call for more cars.

## UNION OF CANADIAN MUNICIPALITIES.

At the concluding day's session of the Union of Canadian Municipalities held in Calgary, Alta., the principal business was the election of officers which resulted as follows:—Hon. Past President, J. J. Ward, Toronto, Alderman Lavelle, Montreal; Hon. Past Vice-Presidents, Mayor Stevely, London; Mayor Keny, New Westminster; President, R. C. Cochrane, Reeve of Blanchard, Man.; First Vice-President, W. Sanford Evans, Winnipeg; Second Vice-President, Mayor Chisholm, Halifax; Third Vice-President, Alderman McGee, Toronto; Hon. Secretary-Treasurer, W. D. Lighthall, Westmount, Que. The union will meet next year in Toronto.

## AGES AND TERMS OF SERVICE IN MUNICIPAL LABOR FORCE.

In their investigation of the Boston Water Department, Metcalf & Eddy, of Boston, consulting civil engineers to the Finance Commission, made a searching analysis of the records of ages and terms of service of municipal employees. From their exhaustive report, which has just been published, the following is quoted:—

"The average in April, 1907, of the labor force in the Distribution and Income Divisions of the Water Department was forty-nine years, and the average length of service about thirteen years; and, what is not apparent from this simple statement of fact, the average age at time of appointment is much greater now than it was some years ago, so that if the present policy of appointing men upwards of forty or even fifty years ago to do the work properly belonging to young and vigorous men is persisted in, the efficiency of the labor force is bound to be more and more seriously affected. This becomes clearly evident when we consider that most of the employees to-day are drawn from the ranks of city-bred men, whereas twenty years ago the labor was drawn mostly from the country, and moreover from a class accustomed to hard manual labor.

The average ages at time of appointment of the men in the labor force are shown in the following tabulation:—

**Ages at Time of Appointment of Men Now in Labor Force.**

| Age when appointed. | Distribution Division, Per Cent. of Force. | No. of Men. | Income Division, Per Cent. of Force. | No. of Men. |
|---|---|---|---|---|
| Under 20 .... | 4.0 | 19 | 4.6 | 3 |
| 20-25 ..... | 9.1 | 43 | 7.6 | 5 |
| 25-30 ..... | 18.4 | 87 | 12.2 | 8 |
| 30-35 ..... | 16.5 | 78 | 16.7 | 11 |
| 35-40 ..... | 16.3 | 77 | 19.8 | 13 |
| 40-45 ..... | 12.8 | 60 | 16.7 | 11 |
| 45-50 ..... | 14.4 | 68 | 12.1 | 8 |
| Over 50 ..... | 8.5 | 40 | 10.3 | 7 |
| Total ..... | 100.0 | 472 | 100.0 | 66 |

A study of the relation of length of service to ages of employees indicates clearly that the average term of service does not keep pace with the increased age of employees.

From our study of this department, we have concluded that, provided the general policy be adopted of appointing young and vigorous men under forty, or better, under fifty-five years of age, in filling the vacancies, there will be found sufficient positions involving comparatively easy work to care for the superannuated or incapacitated men without prejudice to any city's interests, and without the adoption of a pension system, with its attendant cost and serious danger of abuse, if a proper system of promotion or gradation of work be followed. It must be admitted, however, that with existing conditions, the department is overloaded with superannuated men, many of whom had already passed their years of active service or usefulness at the time of their appointment to the city's service, and the city is now, in effect, virtually pensioning these men at full pay, a rate at least double that contemplated by the ordinary pension system, and far in excess of any pension rate of which we know; a rank injustice to the men who have grown old in the service of the city, and an influence demoralizing in its effect upon the efficiency of the department."

## A NUMBER OF LETTERS LIKE THE FOLLOWING ARE BEING RECEIVED DAILY.

To the Business Manager,
Canadian Engineer,
Church St., Toronto.

Dear Sir:

I enclose cheque value $4.00 being two years' subscription for Canadian Engineer for the years 1910-1911.

Receipt in due course will oblige.

Yours truly,
(sgd.) W. S. Brooke.

I must congratulate the Editor and all connected with him, in the great strides the paper has made the last 12 months. Your efforts ought to be greatly appreciated by the profession. Your paper is invaluable.

E. A. James, Esq.
Managing Editor,
The Canadian Engineer,
Church and Court Sts.
Toronto, Ontario.

Dear Sir:

I enjoy the Canadian Engineer very much. It has improved to a marked degree in the last year or two and I must congratulate you on having brought your paper to its present high standard as a technical journal.

Believe me,
Yours very truly,
(sgd.) H. B. R. Craig,
City Engineer.

July 28th, 1909.

Red cross rules for the prevention of railroad accidents have been printed very attractively by the Monetary Times Printing Company, Toronto, Ont. They will be distributed free of charge to railroads or traction companies desiring to use them as placards or as counter literature. Seven simple rules, easily remembered, would save many lives, and the railroads much money, if widely distributed. The following note of caution is added:—"Prevention of accidents and injuries by all legitimate means is a personal duty which everyone owes not to himself alone, but also to his family." All orders for the cards will be promptly filled without charge.

MR. H. C. SIDDELEY, London manager of the Lancashire Dynamo & Motor Company, of Trafford Park, Manchester, was in Toronto this week on his way through after having visited extensive contracts in India, Africa, China and Japan. The Lancashire Dynamo & Motor Company has just put in three 1,000 k.w. sets for the Imperial Japanese Government.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWAGE DISPOSAL.

### Removal of Putrescibility.

Chapter I.

(Introduction.)

In previous articles the subject of removal of solids has been treated; it is now proposed to give some attention to methods calculated to remove the putrescible characteristics in sewage.

Fresh sewage as mixed with water and delivered at outfall works has very little smell, it presents a dirty grey appearance, and has a general resemblance to water used for scouring purposes. On the surface of the sewage may be observed floating particles of vegetable matter, matches, corks, fruit skins, etc., and lumps of fæcal matter. If the sewage has travelled any distance, fæcal matter and paper will be broken up by the friction on the sides of the sewers.

A glass of fresh sewage on being allowed to stand for an hour will settle out a thin layer of sediment, the liquor remaining of a dull dirty grey appearance, the amount of turbidity as far as the eye can tell being constant. The amount of sediment which settles at the base of the glass in about an hour represents approximately 70 per cent. of the suspended solids in the sewage, the amount of settlement

First Bacteria Beds, Sutton, England.

depends, however upon the character and specific gravity of the solids. If the sewage is allowed to stand for a longer period practically no further settlement occurs, the remaining 30 per cent. of the solids being of a specific gravity either equal to or lighter than water. It has been demonstrated, as far as the removal of solids is concerned, that a 70 per cent. removal is all that is practically necessary for preliminary treatment, if the future aim be the ultimate purification of the sewage.

If there is added to the above glass of sewage a certain amount of alumina or other coagulants the amount of natural settlement can be artificially increased, in fact the amount of sediment may represent from 80 to 90 per cent of the original suspended matter. The remaining liquid will, however, remain of the same dull grey dirty colour, although the amount of turbidity will have slightly decreased. This method of sewage treatment is called "chemical precipitation."

If in the first instance, after one hour of natural quiescent settlement, the turbid liquid is drained off and treated by mechanical filtration by passing it through fine filter paper, turbidity can be practically removed. One passage through fine filter paper will probably produce no difference as far as the eye can tell. Repeating the process several times through the same filter paper, clarification is gradually obtained as the pores of the paper become smaller by the retention of the fine suspended matter. This process may be continued until there is no residue left on a clean filter paper. There is now produced as far as the eye can tell a glass of absolutely clear water. This method of sewage treatment is called "mechanical filtration" or "clarification."

If the glass of mechanically filtered sewage which appears to be absolutely clear water, be allowed to stand for some time, it again becomes turbid, and commences to give off a putrid odour, if allowed to stand for a considerable length of time, the odour gradually disappears, the liquid clears itself, and a floculent thready film forms at the base of the glass which if examined under the microscope is found to consist entirely of micro-organisms. This method is called "biological treatment," and if combined with mechanical filtration it is then called "biological filtration."

The glass of clarified liquid produced by the exacting process of successive passages through fine filter papers, still remains sewage. All that has been done by the process is to practically remove the whole of the suspended matter. Solids remain in the sewage in solution. These remaining solids in solution form the greatest proportion of the total solids in the raw sewage. A chemist by the aid of analysis would not have the slightest difficulty in describing this glass of apparently clear water as absolute sewage. He would pronounce the sample as putrescible and say, that, it was capable of absorbing a certain amount of oxygen from the atmosphere. The oxygen being attracted by the organic compounds in the liquid, the measure the amount of oxygen which can so be attracted would be the measure of the amount of organic impurity, and the amount of putrescibility which the liquid must undergo in order that the necessary chemical changes take place which will render the liquid no longer sewage.

Only an exact appreciation of the above phenomena can make clear what is now meant by sewage purification. The whole process of chemical precipitation was built on the hypothesis, and a clarified sewage liquid was no longer sewage, and was rendered incapable of producing further nuisance on discharge into a stream. How erroneous this hypothesis has proved itself, has been made evident both by practical experience and scientific enquiry. At Sheffield, England, about eighteen years ago, over $5,000,000 was spent in putting down a complete chemical precipitation plant. The object here was to remove an acknowledged nuisance caused by discharging raw sewage into the River Don, which seriously affected the town of Rotherham situated below on the same river. At Sheffield the sewage was treated by both primary and secondary quiescent tanks and lime as a precipitent added. The liquor passing into the Don had all the appearance of clear water. At first so great was the faith of those interested in the installation, that occasionally a glass of the clarified liquid was drunk as an illustration of confidence. Two years ago, however, an injunction was obtained

against the City of Sheffield, compelling them to cease polluting the river Don with this clarified liquid. The fact is the nuisance from the river has remained undiminished, and the works have been of no avail. The clarified liquid had to be rendered non putrescible by some means or another, the works performed no such process, so the objectionable process was continued in the river just as it was before the works were started. Eighteen years ago Sheffield acted in accordance with its lights and upon the best advice it was then possible to obtain. The point is, however, not that Sheffield was to blame, but that Sheffield was unfortunate. The same cannot be said of towns which at the present date take no lesson from the errors of the past, and spend money in so called sewage purifications works, which may have the effect of weakening the sewage to the extent of the removal of solids, but have no purification effects whatever.

Efforts in connection with the removal of putrescibility in sewage, have during the past few years occupied primary attention, and it is now generally taken for granted that in this connection the whole crux of the matter lies. It is understood that no matter to what extent raw sewage is chemically sterilised, such sterilisation only has the effect of retarding putrescence for a time, and that, as soon as the strength of the sterilising agent becomes exhausted, putrescence commences, and the process of the change from the organic to the unorganic must take place. Sterilisation of raw sewage has, therefor, only a temporary effect, and may be of use locally to retard a nuisance until such time when the sewage is removed to a safe distance, but cannot be interpreted as a final method of sewage disposal.

The chief nuisance attached to sewage whether collected in enclosed spaces, or discharged into running or quiescent waters, is the effect of the process of putrescense. We have said that fresh sewage, diluted by the water carriage system, presents very little smell, and it is only when allowed to stand and chemical changes commence that foul odours are given off. It is therefor obvious that if this chemical change of putrescence can be effected rapidly under control and with a minimum of nuisance, the chief objection, from a nuisance point of view, of discharging the effluent sewage into a stream or lake is removed. The removal of putrescibility is, therefore, practically the standard of purification required in Great Britain, Europe and the American States.

The Fifth Report of the British Royal Commission states page 221, par. 322, as follows. "For the guidance of local authorities we may provisionally state that an effluent would generally be satisfactory if it complied with the following conditions:—"

"(1). That it should not contain more than 3 parts per 100,000 of suspended matter; and

"(2). That, after being filtered through filter paper, it should not absorb more than

" (a). 0.5 part by weight per 100,000 of dissolved or atmospheric oxygen in 24 hours.

" (b). 1.0 part by weight per 100,000 of dissolved or atmospheric oxygen in 48 hours, or

" (c). 1.5 parts by weight per 100,000 of dissolved or atmospheric oxygen in 5 days.

"At many sewage works which we have had under observation effluents of this class are uniformly produced."

A sewage effluent presenting an analysis such as the above is practically non-putrescible, incapable of producing any further nuisance no matter where discharged, but is not by any means a drinking water, or fit to mix with a drinking water supply, unless highly diluted. What then is the true meaning and bearing of the term "removal of putrescibility?" Surely if sewage disposal is to be effective, it should mean that there is no longer any danger to a water supply from an admixture of the purified effluent. Such, however, is not the case as far as the mere removal of putrescibility is concerned. Removal of putrescibility simply means that the effluent is not liable to further putrefaction will not redissolve, and is incapable of giving off foul gases or odours; and further that it will not absorb oxygen from the water receiving the effluent and thereby endanger fish life. Fish are not poisoned by sewage, but are asphyxiated for lack of oxygen in the water.

The Royal Commission page 218, par. 309, state: "We are satisfied that rivers, generally those traversing agricultural as well as those draining manufacturing or urban areas, are necessarily exposed to other pollutions, besides sewage, and it appears to us, therefor, that any authority taking water from such rivers for the purpose of water supply, must be held to be aware of the risks to which the water is exposed, and that it should be regarded as part of the duty of that authority, systematically and thoroughly, to purify the water before distributing it to their customers." Further in par. 310, the commission state "we do not consider that in the present state of knowledge, we should be justified in recommending that it should be the duty of a local authority to treat its sewage so that it should be bacteriologically pure."

If the above be the case, the question may be asked, why then the necessity for sewage purification at all, even to the extent of the removal of putrescibility? The answer is a plain practical one. If raw sewage, which has not first been rendered at least non-putrescible, be discharged into a drinking supply source, it is practically impossible by filtration or even by methods of sterilisation to produce satisfactory drinking water from such a source. The removal of putrescibility means the reduction of the original bacteria in the sewage, it also means an effluent in which pathogenic bacteria cannot long exist because of lack of nutriment. It further means an effluent which can be practically and economically sterilised if reqired. Absolute sewage purification must consist of three processes: 1st. Removal of Solids. 2nd. Removal of Putrescibility, and 3rd. Sterilisation. The point is whether it is necessary to apply the 3rd process to the non putrescible sewage or apply it to the drinking water itself. It is obvious, for the reason, that a stream may receive other pollution apart from sewage, that even if the 3rd process was applied to the sewage effluent, it would still be necessary to also apply it to the water before distributing it for drinking purposes. There is obviously no reason for this double application of a process, except perhaps under rare circumstances. It is, therefor, now practically agreed that an authority has done its duty by presenting a sewage effluent purified to such an extent, as to make it possible within practical limits for the authority to also treat satisfactorily its water supply drawn from a source receiving a sewage effluent.

To be Continued.

## THE DIVIDED RESPONSIBILITY IN REGARD TO PUBLIC HEALTH.*

By Dr. C. A. Hodgetts

(Chief Health Officer of Ontario).

For the enforcement of all public health measures the personal or individual responsibility must ever rank as the most important factor. Municipal councils may pass by-laws and legislatures enact laws. It is just here at this point both bodies rise to their responsibility, but fail to enforce the same, or, as is too often the case, but imperfectly enforce them, or where an attempt is made to provide for some system of inspection—as is often necessary—this is done by the officials in a perfunctory manner, whereby there is set up a false security, and good intentions are thwarted.

It must ever rest with the certain number of right-

* Read before the Saskatchewan Medical Association, July 7th, 1909, at Saskatoon.

thinking citizens of a community to act as watch-dogs in keeping any particular municipal health authorities up to the highest standard of efficiency, so far as regards municipalized public health, for, as Huxley correctly states: "The higher and more complex the organization of the social body, the more closely is the life of each member bound with that of the whole," and failure in action results seriously to a community.

Unfortunately in the past it has been the custom for most men and women to think they should do nothing but that which it pleases them to do without the least reference to the welfare of the home, and particularly as to the welfare of the community in which they live. In fact, if we look around the world from the sanitarian's standpoint, every prospect pleases and only man is vile. It is time the people realized to the full all the meaning of the words of Milton: "Accuse not nature; she hath done her part. Do thou thine."

These are times for action, and it is in the personal responsibility of the individual wherein lies the success or failure in attaining all that public health means to a people. It begins with the parents in the prenatal period of their offspring, and continues with increasing import until their offspring in turn leave the home to assume similar responsibilities.

Canon Kingsely very truly stated some fifty years ago, it is our duty to see that every child that is born shall be developed to the highest possible pitch of development in physical strength, in intellect and virtue. And if this most desirable end is to be reached, one of the chief factors must be by the adoption and enforcement of all the known rules of hygiene in the home within municipal limits, and in conformity with uniform State enactments, wisely and properly directed and assisted.

Unfortunately for the nation there is a widespread ignorance on the part of parents of the principles, the knowledge of which is essential in properly caring for infants. This alarming and widespread ignorance is most disastrous from a national standpoint, and the fact that their helplessness has not gained for them the interest they deserve in the home, we must claim it as their right as citizens, and by municipal and State enactment provide for that most valuable of all national assets, that by which it lives and is perpetrated, viz., the lives of its children.

In respect to many of the small tombstones and of the unmarked graves, how correctly could be written the epitaph: "Victims of Parental Ignorance in respect to Public Health." It is no exaggeration to say that 75 per cent. of the deaths of all first-born infants are preventible, their deaths being largely due to parental ignorance. I include both father and mother in respect to the rearing of their offspring.

It must be remembered that ignorance of the temporal law is no excuse. How much greater, then, is the personal responsibility where the health of the nation's greatest wealth is concerned?

I may be pardoned for a brief reference to what is, perhaps, of still greater moment than the care of children, one which has been felt by at least one of the great European nations, and one which certainly would have been considered by one nation of this continent had it not been less prominent, owing to the great tide of immigation, which has increased by leaps and bounds its population. I refer to that very important question popularly known as race suicide—that damnably pernicious and criminal practice now so common in all classes of the community, but particularly in vogue amongst the wealthy and those of the middle walks of life—the prevention of conception. The guilty parties are to be found in both sexes, and the guilt may be placed at the door of both fathers and mothers, for if the former are the chief offenders or criminals as regards prevention, certainly the latter are the criminals in respect to the inducing of miscarriage, and thereby bringing on the physiological process of menstruation at a much earlier period than would be normally the case after conception has once taken place.

This is a subject in which some few of the members of the medical profession have at least in some portions of the country been too much identified with, and if for nothing higher and better, certainly for the credit and ennobling of the medical profession, the sooner such men are prevented from countenancing such pernicious practices under the cloak of a medical license the better.

Certainly but little progress will be made against the insidious inroads made by these pernicious customs into the social life of our people until the men and women of our country are educated as to their great evil, and of the dangers which follow their practice.

Returning again to the question of the children—a child may be taught in school a few of the cardinal rules of hygiene, but if he returns to a home where every rule of health is ignored, what profiteth the child? Similarly, he may be given the best physical instruction, but much of the good is undone if the home be dark and sunless and God's fresh air is regularly excluded during the eight or ten hours he spends in sleep, all on account of the ignorance of fond parents.

**Dr. C. A. Hodgetts.**

It is not the purport of this paper to indicate how the knowledge appertaining to public health shall be disseminated to the people; enough has been said to indicate the lines of individual responsibility. Parents must know the laws of health before sanitarians can hope for them to exemplify the same in their lives—many know of them in the abstract, but to be of any worth they must know them of a truth, and they must teach them to their children. Parents must realize the importance of the body as well as of the soul and mind. They must know that it is their duty to study the rules of hygiene as they apply to growth and development of the body and the adoption of all preventive measures which will protect the child as it passes through life. They must realize the importance of the sound body as well as of an educated mind, for in life's struggle the latter will little avail if the offspring is a mental prodigy.

And looking higher still, and considering the body as the earthly temple, surely it is essential, it is fitting and proper that the individual should know how to preserve it in health, strength and purity, for certainly as regards our bodies each one should realize his responsibility.

Of personal responsibilities perhaps that of the physician is the most onerous. Certainly the great advances made in medical science along the lines of serum therapy, the application of toxines, and similar therapeutic agents, as also the general and particular application of preventive medicine, all enhance their responsibilities, and the medical practitioner who does not teach and practice to the full public health is simply a charlatan.

It will not suffice as at present for medical colleges and licensing boards to relegate hygiene or public health, or whatever term they choose to apply to this important branch of medicine to a third rate, or even second rate position. To know how to prevent illness is more important than to know how to stop a cough. This latter is the prerogative of the patent medicine man and requires no skill, but to prevent illness requires that the medical practitioner shall have more than the mere knowledge of how to vaccinate, how to properly isolate a case, and subsequently disinfect. It calls for a knowledge of accurate bacteriological, physiological, chemical and the public health laboratory knowledge, as well as the practical application of all that is represented in these groups of medical instruction in so far as they relate to the maintenance of the human body in normal physiological health under all its varying conditions—the study of human environment—all of which knowledge must be given in medical colleges everywhere; and the day is not far distant when "preventive medicine" must rank as the most important subject in the medical curriculum, and curative medicine, and diagnostics and surgical skill and dexterity be merely what they should be, the useful and proper allies of the Goddess Hygiene, and placed in that limbo from which public health is only now coming forth in its might and power to work great and as yet untold blessings for mankind.

Dealing with public health from the municipal standpoint, the fact must be recognized that personal liberty has its limits, and the relation of man to man requires the formation of rules of action which have for their object the preventing of one man taking from another those rights, economic and individual, which are essential to present-day happiness. So, also, are health rights to be obtained through common action, and thereby the better is the guarantee that we shall work together not to injure either our own health or that of our neighbor, and that our neighbor shall not injure our health.

Many are the municipal health laws, codes or ordinances—they are all similar, having been copied from one another. The powers they confer upon municipalities are often very great. Some of the laws are bad by reason of their not conferring upon local authorities the power to enforce the same; others are good. Laws define rights—men enforce them. and law-making is one thing, law enforcement another, and doubtless thousands of lives are being lost every year, millions of dollars being spent on curing disease and caring for those incapacitated from labor thereby, and millions of days are taken from industrial pursuits, and in the end the working life of nations is materially shortened because health laws are not enforced, both by the individual as well as the municipality.

One illustration will suffice. What law will every stop the present waste of infantile life due to the character of the milk supplied in all large cities, unless dairies are systematically inspected and cleanliness enforced, unless milk is kept at a low temperature (50°) from immediately after milking—in the creamery, on the train, at the receiving station, in the milk wagon and milk shop? Not until dealers scald and cleanse their cans, unless licenses are taken from farmers, creameries and retailers who violate the law, and not unless mothers are taught to scald and thoroughly cleanse bottles, nipples, cups and dishes from which milk is fed to infants, will this be remedied.

Here is an illustration of the interdependence of individual and municipal responsibilities. We may discuss the subjects of certified milk, pasteurized milk, clean milk, or, indeed, any other kind of milk, but until the proper authority is vested with full power to control the supply from dairy to consumer along some other channel than through the many by which milk now reaches the consumer. We may inspect and inspect milk until you are dead, for at the best the method is imperfect, and inspection cannot be made perfect.

We cannot guarantee the present impure milk of our cities and towns under the most rigid [illegible] how, then, will those who wish to load up the system by pasteurization guarantee that each and every vendor deals out a correctly pasteurized milk?

They want a precise and exact laboratory method to be conducted daily by every dealer under the highest sanitary requirements, and the municipality to guarantee that each dealer sells pasteurized milk that is pasteurized milk.

Can this be done under present methods? Here is a point where we cannot take the word of the individual or accept the guarantee of the municipality, owing to the difficulties of inspection and supervision.

Is it not, therefore, a point where the municipality should, for the benefit of the community as a whole, simply step into the breach and establish a milk depot, or depots, as the size of the municipality may require, to which the milk shall be delivered by all licensed and inspected dairymen, paid by the municipality for the same on a basis of quantity and quality? Let the municipality deliver the milk pasteurized or otherwise as the health authorities decide, in regular routes, with no overlapping in delivery, and let all be upon a cash basis as between the municipality, the furnisher and the consumer, at the minimum cost of inspection and where the maximum of purity will be assured.

In this country the Legislature of each Province is given full control over municipal institutions, it having been evidently thought better to teach each locality to manage its own affairs in keeping with the old proverb: "If you wish anything well done, do it yourself."

In brief, the situation is this in most civilized countries: When you are born, your name must be registered with the proper city or municipal official; when you are of school age, the municipal authority provides you with a school and teacher, and requires your attendance. Sometimes you are provided with school books free of charge. When you go out upon the streets you find them paved, lighted and cleaned by the council, and you cannot under penalties remove or alter the pavement or pollute the street. Your life and property are protected by police and firemen provided by the council, it demands a tax should you engage in certain classes of business, and should you be fortunate enough to build a house you must submit your plans and secure a permit.

As to conveniences, the council, sometimes assisted by Carnegie, provides you with a free library, it provides officials to inspect the quality of your food and drink, it removes your garbage from your yard and your sewage from your house, and provides you with water, with parks and squares, and a hundred other things, and, if poverty overtakes you, it will aid the charitable in giving you a home, and when the end comes it will, if your friends do not claim your body, bury it, and before doing so register the facts of your death. Thus, from birth to death the municipal council affects our lives. The individual rights of the citizen are vested in the council, and to it for all these privileges we pay taxes, and thereby the rich unconsciously provide many things which have important bearing on the public health which those in more humble walks of life could not otherwise afford. Thus, in benefiting themselves they unconsciously add very materially to the improvement of the health of the masses.

It will thus be seen that in this evolution of municipal government as apart from State or Federal laws the responsibility of the enforcement of a large amount of public health measures has been placed upon municipal authorities, and in the past the central authorities have been satisfied with the enactment from time to time of more advanced public health laws, but the enforcement thereof has usually been placed upon local health authorities, and the central authorities have thus been relieved of any responsibility, though willing at all times to tender advice, usually through the Central Board of Health. With such a system generally prevailing it cannot be said the results have on the whole been satisfactory.

In regard to such an important group of questions embraced under the head of public health, it is essential they

must be uniform for the larger community of people as comprised in a State, Dominion or country in order that they may be efficient, but in so far as the higher power enacts these laws for various municipalities whose councils change from year to year as the municipal elections recur, so the administration of the laws are subject to more or less change. And further, as the inhabitants of a State, Dominion or country are really residents of different municipalities for longer or shorter periods of time incident to the many modern means of transit it is essential for good government, for the affording of the highest protection to all, that, while details as to the adoption of any particular set of health measures must remain with the municipal authorities, yet the supervision and the power to enforce, if necessary, should be vested in and the power judiciously exercised by the Government which enacts them, but the expenses of their enforcement should be a cost chargeable to and collectable from the municipality which fails in their enforcement, otherwise it will be found that municipal authorities will readily yield up their duties to the larger and more powerful central body.

In public health matters the municipality would naturally be expected to work out its own salvation. The common health interests of the individuals living in the municipality, both men and women, and particularly the children, being of such moment as to require the rigid enforcement of the most modern health requirements.

But it is too often the case that local health by-laws or codes of health, although upon the face of them bearing the impress of all that is good for the community, yet in the method of enforcement or the manner of inspection are in the end really a farce, and the strong arm of the Government, which created their local powers must for the general good retain the power of enforcement.

In conclusion, a short reference is desirable to the responsibility of the national Government in respect to all that appertains to the health of the people. It will not suffice for any Federal Government to say that the question of public health is relegated to this or that particular State, provincial or territorial legislature—that the health of any particular city, or country, or geographical district is a local matter and does not concern the people of any other portion of the country, and if the local authorities will not engage in the solution of their own particular district the national Government should not. This is a false premise, for many public health questions are national in their import. Indeed, we may go further. Many health questions are international, and can, therefore, only be dealt with by nations; for instance, the sewage pollution of the waters of the Great Lakes of this continent, regarding which we in Ontario are deeply interested. The preservation of these waters from pollution by sewage is of interest and import to all who live along their shores, as well as the hundreds of thousands who yearly visit them from all portions of the civilized world. The many points involved in the question cannot be dealt with by the Province, but must be considered by the nation. It is to the national Government we look for a protection as regards the health of those who seek homes in our midst; that responsibility has in part been acknowledged; but cannot we go further? What of the valuable lives born each year to the fathers and mothers of this country? Are they not a more valuable asset than all the immigrant population? Truly, the wealth of the nation is in its babies, and, being national, the Government which represents that wealth should do more in their behalf. Here, in Canada, the national Government has in its wisdom set an example by taking over the health of our cattle, which is a part of our national wealth; but what of the people's health? Have they no interest therein? Time fails me to indicate all their responsibilities. Surely the physical conditions are at least of national import, and should have a properly constituted National Health Department, working in co-operation with provincial, State or territorial departments aided by municipal local health authorities and carefully guarded and directed by public opinion.

In conclusion, public health is pre-eminently a national question, although requiring the assistance of State, provincial and municipal machinery and laws for the proper and efficient working out of methods and the enforcement of laws for the betterment of communities, and it may be necessary for good and efficient government that well-defined lines shall be laid down upon which each of the several governing or legislative bodies in a country shall have power to legislate upon and the limitation of enactment be clearly defined, but for the better enforcement of health laws there must be some central authority, clothed with proper power to act when either individual, municipality, or Province fail to enforce laws adopted for the protection of the health of either an individual, community or district.

It is essential for the carrying out of all laws which in any way relate to the public health that such power be retained and exercised by the national Government, it is essential for the protection of the health of each individual.

Consequent upon financial losses in respect to national wealth as regards agriculture, horticulture, stock-raising and the great manufacturing industries and other branches of national wealth, Legislatures and Parliaments devote annually large sums of the public monies for the improvement of all these branches of the wealth of the nation—colleges have been erected at public expense and large sums appropriated for their maintenance, chiefly devoted to the branches of agriculture; universities have set apart departments to foster agriculture and forestry, and every nation has departments of Government under Cabinet Ministers for the fostering and improvement of the branches of national wealth, but how many have a Minister of Public Health? But few. Or how many have the various branches relating to the health in one large sub-department? But the all of public health is not in the statutory powers of the Government. There are many and great problems of public health that have yet to be worked out, and in the solving of these problems much research work, much experimental work has to be instituted and carried on, many social sanitary problems have to be studied, all of which require the expenditure of money and the engagement of a staff of the best experts the nation can engage. Certainly, the physical training and developments of both boys and girls must be worked out upon national lines. In my opinion, as regards the boys, the best results and at a minimum cost can, and should, be at once secured by some form of modified military drill. It will be necessary that many of the vaccines, serums and antitoxines used in preventive medicines should be prepared by the State at the expense of the people and distributed to local authorities at cost, as the almost prohibitive prices of commerce prevent their general use.

The State must provide well-equipped laboratories. It will not do for any country to rely upon the benevolence or generosity of philanthropists for the studying of the many questions relating to preventive medicine; these must be carried out by the national Government, as they have for their highest object the health of the people, which means its highest wealth.

Surely this is a fit, a proper sphere for the nations of the earth to work in—none higher, none better, and none of more moment or greater import. The greater the nation and the more dense the population, the greater the present responsibility, while for a young nation, one looking forward to vast increases in population in the coming years, the importance of public health questions is of vital importance as it is entering the threshold of national life, and to a nation such as we Canadians have the honor to form a part there is every necessity for the creation of an Imperial Health Bureau, with its unit in every branch of the Empire, each working in harmony with the General Bureau, and each doing its part of experimental and research and laboratory work. That which may be most fittingly and appropriately worked out by each particular branch, all co-operating and assisting to solve the intricate questions, all of which have for their object the health of mankind and the prevention of sickness and suffering.

## DISCUSSION OF SCLEROSCOPE TESTS.

By J. P. Snow.*

Fig. B. S. is a section of a Bessemer rail rolled at Buffalo several years ago. The rail broke in service with a very square break. Polished and etched it showed very high segregation. The web of the rail was blistered and slivered in rolling to some extent, showing plainly its unsound character. The test shows great lack of uniformity, there being a difference of 14 points in the scleroscope readings at different locations in the head. The experimenter says, "This condition is rather characteristic of the rails of Bessemer origin."

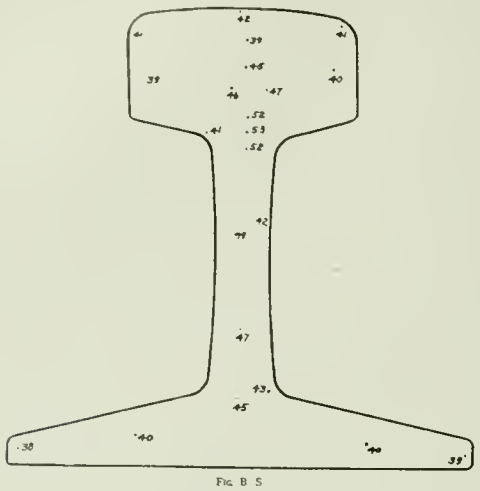


Fig. B. S.

Fig. B is a section of a Bessemer rail rolled at Buffalo in 1908. It is a crop from the top end of a top rail. The match was held 2½ minutes after being recarburized before teeming.

Although the specimen was from the top of the ingot there is a difference of about 3 points in the readings throughout the head.

The section, where polished and etched, showed rather dimly marked segregation. The head and base when planed into and etched showed some dark streaks in the head and light streaks and fissures in the base. The top of the head for ⅛-in. depth was sound.

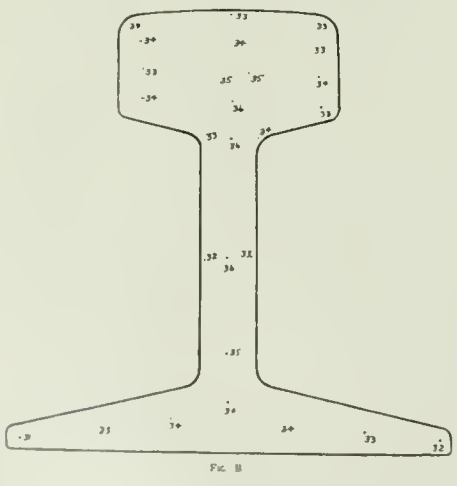


Fig. B.

The experimenter says: "The section as a whole is more uniform than is usually to be found in top, middle or bottom rail of a Bessemer 'ingot'."

Fig. O is a section of open-hearth rail rolled at Bethlehem in 1908. It shows a difference of 6 points in the head, but down the center the difference is but 3 points. In sawing the rail very hard nodules were encountered at various points, especially at the junction of the web and base. The Scleroscope did not seem to indicate this feature, and it is possible that the difficulty in sawing arose more from toughness than from hardness. The open-hearth rails now being rolled at Gary are difficult to drill and saw on account of their toughness. The experimenter says: "The wearing surface is slightly harder than the material about ⅜-in. inward. This condition is just as we should expect to find in a good homogeneous rail." The rail is a 90-lb. "B" A. R. A. section, rolled for the Baltimore & Ohio Railroad. It will be interesting to learn how it proves under traffic.

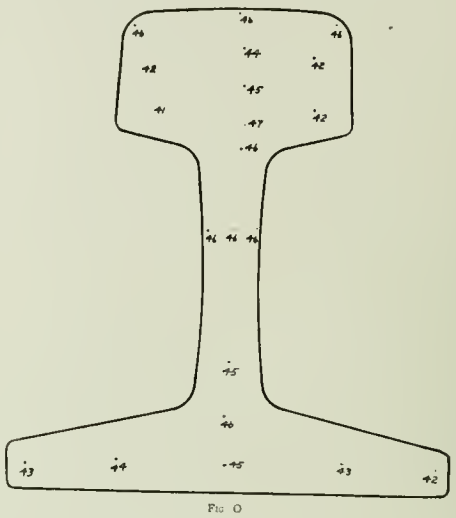


Fig. O.

Fig. M is a section of Manard rail rolled at Steelton. It shows a difference of 3 points in the head, and in fact but 3 points over its entire area. It was impossible to cut this specimen with saws, planer tools or drills, but the Scleroscope readings are not high. It may be that the resistance of certain spots in the open-hearth specimen above was due to toughness similar to that of this specimen.

These tests go to show the value and the limitations of the Scleroscope as a rail testing device. Segregation is an ever-present evil in melt-made carbon steel. Its effect is to concentrate the hardeners at the central part of the head and web. The instrument seems to detect the presence of these hardeners with considerable precision; and it may be possible to fix upon a maximum variation for the purpose of a specification that can be allowed and that will be reasonable. The tests are quickly made and are inexpensive. They might result in detecting badly segregated rails that would not be found by the drop test.

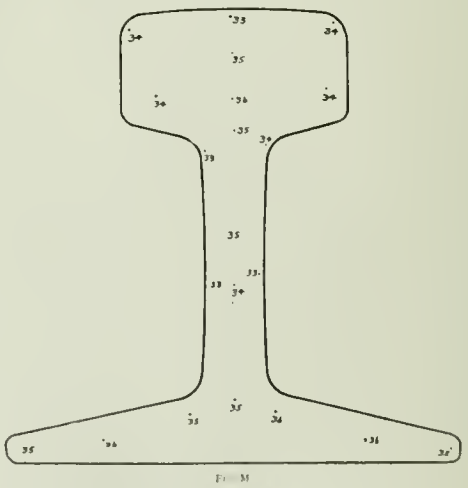


Fig. M.

As a test of the wearing qualities of rails, the description above shows that the instrument has its limitations. The Manard rail resists wear much better than either the open-hearth or Bessemer, while the readings on it are low.

*From Bulletin No. 111 of the American Railway and Maintenance of way Ass. Report.

The highest readings on the Bessemer rail were on metal known to be unsound and of very poor wearing qualities. These facts show that the readings of the instrument have no absolute relation to resistance to abrasion.

The tests were made by Mr. J. H. Gibonney, Chemist for the Norfolk & Western Railway, under the direction of Mr. Chas. S. Churchill, Chief Engineer.

## SOME COMPARISONS OF WOOD AND STEEL TIES.*

By J. M. Meade.†

Carefully prepared statistics for 1907 show that the number of ties used on American railroads, figured in round numbers was 118 million ties for renewal purposes alone, to say nothing of the thousands used in the construction of new lines, etc. This 118 million ties covers the two hundred and thirty thousand miles of main line railroads now estimated by the Interstate Commerce Commission to be in this country, to say nothing of the many thousand miles of side tracks.

Prices of ties have increased rapidly and the railroads will have to deal with this problem, with a promptness that has never confronted them before. Mr. E. E. R. Tratman has collected for the Bureau of Forestry a great amount of information, with reference to the plans, life, etc., of steel, ties; from his reports of six foreign countries using steel ties, the per cent. varied from 25 to 40. His reports also show that a large number of steed ties are used in tropical countries. The attractive feature being that they are proof against the wood destroying insects, so prevalent in those countries.

The question of relative age and cost of steel ties and creosoted wood ties, is an interesting one to all maintenance men. The reports published in our Scientific Journal seem more interesting from England and France, to our track men, than any other foreign countries. These reports show that the steel ties most common in these countries, last from 18 to 23 years, rust being the destroying factor. The life of creosoted wood ties is estimated in this country at 30 years. An up-to-date steel tie, with a weight of 160 pounds, is worth, at the present time, about $2.50 against 80 cents for the best creosoted wood ties.

Our experience in this country, with steel ties, is yet too limited, to say, how long they will last, but it is safe to predict that they will not last much, if any longer, than quoted for England, etc.

An interesting account was recently published by W. Morcom, of Mexico, about the steel ties in use on the Mexican railroad from City of Mexico to Vera Cruz. I have been over this road and saw the ties in question. They would not answer for the heavy rolling stock of this country. The weight being 110 pounds and fastened to the rails, by steel wedges, which all American track men are afraid of. These ties are 8½ feet long and 14 inches wide. They cost $2 in gold at Vera Cruz. The first of these ties were put in the track in 1884. I saw them two years afterwards. The published report, to which I refer, shows that 90 per cent. of these ties are still in use and in good condition, making them twenty-four (24) years old, at the present time. This is the best record, as to life, of any steel ties, of which I have ever heard. They are largely in a dry and mountainous country.

This report brought out another important matter, that steel ties do not do well with rock ballast, account of breakage, but do best with gravel, or ballast of that nature.

It also showed that steel ties must be spaced about like wooden ties, i.e., the same number required to a rail length, experiments having proven that 12 or 13 steel ties to a rail length, are not sufficient, as they broke at the rail seat, whereas, when the number was increased to that of wooden ties, this breakage ceased.

This report also showed that the life of these steel ties have been prolonged by a treatment of hot tar, before they were put in and subsequently treated in a similar way.

From the best data, we can get at the present time, it shows that the life of the creosoted wood tie, is ahead of the steel tie, with the cost more than double for the latter.

With many advantages in favor of the wooden tie and with the adoption of a thicker and broader tie plate, placed on every tie, curved track, and tangent, to protect the wooden tie, against mechanical abrasion, the life of the creosoted, wooden tie, will no doubt, exceed that of the steel, six or eight years.

With these facts staring us in the face, why should railroads hesitate about the use of creosoted ties? Heavier, and broader tie plates, put on every tie in the track, and why should they hesitate about making an investment to reproduce our forests? They have got to come to this and set out trees and raise their own ties. Some are already doing this, the Santa Fe being amongst the number. The sooner they start, the better, for, if all the railroads should commence using steel ties, estimates from experts, show that the iron ore of this country, would be exhausted in about 75 years.

The report to which I referred of the Pennsylvania Railroad Company, was written by Mr. Curtis, and they estimated that if all the railroads were to quit using wooden ties and go to using steel ties, that it would only take two generations to exhaust the iron ore beds of this country. Between San Diego and Los Angeles, they have started tie timber. They now have 8,000 acres and are setting out about 400 acres a year. They grow eucalyptus trees in boxes the same as tomato or cabbage plants. We have a tie and timber department, and the head of this department, Mr. Faulkner, told me within the last two weeks that they estimated it would take about fifteen years for these eucalyptus trees to come into use for ties. I have seen them around Mexico, from 80 to 100 feet in height, and you can get at least 10 or 12 ties out of a tree. After cutting the eucalyptus trees down, they get better ties from the sprouts or stumps than from the original tree. They have within the last two years been using a large amount of eucalyptus ties from Australia. They are also getting some hardwood ties that look exactly like the American white oak; I don't remember the name, but they are from Japan. These ties, from the information I have received cost, delivered at San-Francisco, $1.25. They come by water, and on these from Australia, there is a duty of 15 cents per tie, which we want to get changed if we can. We get some from the Hawaiian Islands, without any duty on them. Those that come from the Philippines, although under the jurisdiction of our country, still maintain the duty and the same is true of those which come from Japan. They all seem to be about alike, 15 cents a tie, making the most of the imported wooden ties $1.40.

My idea is that there is hardly a roadmaster living now, who will see steel ties come into universal use, for the reason that they are too expensive, and if we can get the forests reproduced on the lines that some of the railroads have started, it certainly does not seem to indicate that we are going to run short of wooden ties.

We have recently been experimenting with wooden dowels, and I have brought some samples here. We sent a man to the Old Country, and this is one he brought back. He has in Topeka among the tie wood specimens a creosote tie that was taken out of a track in France. It had been in the track twenty-six years, and had one of those dowels in it, as good as when put in, and I would guess that that tie was good for ten years' service. We have bought a lot of these wooden dowels, and the screw spikes that go with them, and put them in about a year ago. A few months ago, in Missouri, we made another experiment with them and we have received orders to put in twenty miles of that kind of fastenings. We regard it the best form of construction for

* Read at the Roadmasters' Convention, Milwaukee, Wis.

† Engineer Eastern Grand Division, the A., T. & S. F. Ry., Topeka, Kans.

fastening the rails to the ties and, as I understand it, there is very little more expense than the ordinary track spike. One of our master mechanics has invented a machine that sits on the gasoline car with bits to bore those holes, so that the question of labor in putting them in has been reduced to a minimum. I do not know whether many roads are adopting them or not, but I do not believe it will be very long before you will see this form of fastenings in general use.

## TWO GIANT ELECTRICALLY DRIVEN POWER SHOVELS.

The largest electrically operated power shovels ever constructed, having buckets of four cubic yards capacity, and equipped with Westinghouse motors and automatic control, have recently been placed in the service of the Dolese and Shepard Company of Chicago, for mining rock in its limestone quarries.

The hoist movement of these two 110-ton machines is actuated by a 200-horsepower, 220-volt, series-wound, direct current Westinghouse type M.T. mill motor running at 415 revolutions per minute; the thrust motor, controlling the movement of the dipper handle, is an 80 horsepower machine of similar type; while the swing boom is operated by an 80-horsepower motor. Each motor is controlled independently by Westinghouse type "A" automatic magnetic-switch controllers which secure the greatest nicety of operation of the heavy bucket. This form of control protects the motors from any heavy overloads which may result from the bucket striking solid rock or other obstruction, by opening switches to

introduce resistance into the motor circuit. The control panels and resistances are mounted in the rear of the cab, while the controller handles are conveniently placed under the hand of the operators.

The hoist and swing-boom motors are mounted within the car, as shown in one of the accompanying illustrations. The thrust motor is placed out on the boom, communicating its motion to the bucket staff through reducing gearing connected to a pinion engaging a rack on the staff. The power circuit to the shovel is completed through a feed cable, carried on a retractile reel on the shovel cab, and through the rails on which the shovel advances. The shovel may also be fitted with a standard trolley for driving power and for propulsion on ordinary electrified track. The machine may then attain a speed of five miles an hour.

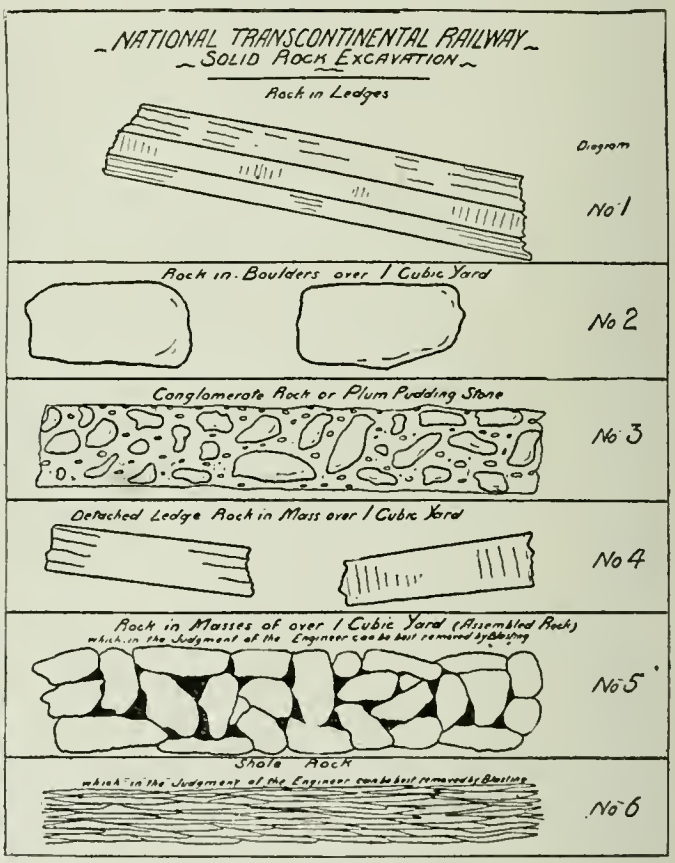
Compared with the steam shovel, the electric-driven excavating apparatus has been found to present marked advantages of simplicity, economy and ease of operation. The hauling of water and coal is avoided; fewer operators are required to handle the machine; and a considerable saving of time is noted. For example, the cost of operating a certain electric shovel with 75-horsepower hoist, 30-horsepower thrust and 20-horsepower swing-boom is $0.164 per cubic yard of gravel, clay and sand, while similar work performed by steam shovels would cost from three to four cents per cubic yard.

## TRANSCONTINENTAL CLASSIFICATION.

Classification of material excavated in country where solid rock, loose rock, hard pan and earth are met with is at best a difficult task and on every railway line small or great there has been adjustments, etc.

The resignation of Mr. Hugh Lumsden, Chief Engineer of the National Transcontinental Railway brings to mind the Hodgins charges and the difficulties that arise on such large work.

In September, 1907 Mr. Lumsden felt the pressure of the work and realized that the building of a road by a commission, Government appointed and Government supervised was much different from work for a railway company. He said:—"Personally, I feel that matters are so different under a government commission, whose powers are limited by the act, from what they had previously been under a corporation, who could act on their own initative and take the responsibility of making such modifications in contracts as now suggested by me in just such difficulties as are now being experienced in district 'F,' that unless some relief can be given, the strain and worry connected with my present position is more than I can stand, especially as the salary is not in proportion to the responsibility involved."


NATIONAL TRANSCONTINENTAL RAILWAY
SOLID ROCK EXCAVATION
Rock in Ledges
Diagram No 1
Rock in Boulders over 1 Cubic Yard
No 2
Conglomerate Rock or Plum Pudding Stone
No 3
Detached Ledge Rock in Mass over 1 Cubic Yard
No 4
Rock in Masses of over 1 Cubic Yard (Assembled Rock)
No 5
Shale Rock
No 6

### The Specifications.

The specifications on this work, provided that grading should be commonly classified under three heads: Solid rock, loose rock, and common excavation, each of which was described as follows:

34. Solid rock excavation will include all rock found in ledges or masses of more than one cubic yard, which, in the judgment of the engineer, may be best removed by blasting.

35. All large stones and boulders measuring more than one cubic foot and less than one cubic yard, and all loose rock whether in situ or otherwise, that may be removed by hand, pick or bar, all cement gravel, indurated clay and other materials that cannot, in the judgment of the engineer, be ploughed with a 10-inch grading plough, behind a team of six good horses properly handled, and without the necessity of blasting, although blasting may be occasionally resorted to, shall be classified as loose rock.

36. Common excavation will include all earth, free gravel or other material of any character whatsoever not classified as solid or loose rock.

To assist the Resident Engineers in interpreting these clauses and to provide for uniformity in classification the chief engineer distributed a diagram similar to the one given here adding notes of explanation.

No. 1. Is a mere matter of measurement by the Engineer.

No. 2. Is a mere matter of measurement by Rock Measurers.

No. 3. Is a mere matter of measurement by the Engineers.

No. 4. Is a mere matter of measurement by Rock Measurers.

No. 5 and 6. To form a judgment as to whether or not it is best removed by Blasting, the Chief Engineer must view the work in progress or leave it to be decided by the Engineer in charge, whose duty it is to frequently visit the work during its operation and be governed thereby and act accordingly.

Before these specifications were incorporated into the contracts between the Commission and the contractors they were as provided for by the seventh section of the Governments agreement with the G.T.P. Railway Company, submitted to the railway company.

Section seven reads as follows:

"In order to insure for the protection of the company as lessees of the eastern division of the said railway, the economical construction thereof in such manner that it can be operated to the best advantage, it is hereby agreed that the specifications for the construction of the eastern division shall be submitted to, and approved of, by the company before the commencement of the work, and that the said work shall be done according to the said specifications and shall be subject to joint supervision, inspection and acceptance of the chief engineer appointed by the government and the chief engineer of the company, and, in the event of differences as to the specifications, or in case the said engineers shall differ as to the work, the questions in dispute shall be determined by the said engineers and a third arbitrator, to be chosen in the manner provided.

The trouble commenced when the G.T.P., Railway Company engineers and inspectors attempted to revise the classification submited by the Government engineers; the contractors refusing to recognize the right of the G.T.P. Railway to interfere.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7562—July 15—Approving two forms of Bill of Lading for joint use in Canada. (See copy of Order attached.)

7563—July 12—Approving Uniform Code of Operating Rules for Canadain Railways. (Cannot send copy of Rules as only two are filed; one copy for Board, and the oher furnished Mr. W. W. Ashald, Superintendent of Telegraphs, G.T.R., Montreal, who was a member representing the Railways on the Committee.)

7564-7565—July 6—Authorizing the Grant Trunk Pacific Railway Company to make corrections on plans of its main line, with respect to property of Messrs Marsan and Girouard in connection with location of the railway, through Edmonton, Alberta.

7566—July 22—Authorizing the C.P.R. to construct a spur commencing at a point on its right of way immediately south of Block 24, between Young and Scott Streets, Regina, Sask., extending thence in a westerly direction crossing lots "B" and "A" along Eighth Ave., to the easterly limit of Broad Street together with a system of ten subsidiary spurs extending from the first named spur, across parts of each of the following blocks, also continued down the full length of the lane in each block: 184, 185, 186, 187, 188, 189, 190, 23, 24 and 25.

7567—July 15—Refusing application of the C.P.R. for authority to construct spur, commencing at a point on its station grounds at Fort William, at a distance of 220 feet, measured westerly from the western side of Leith Street, thence running across and along Hardisty Street, in a north-easterly direction to a point 140 feet westerly from the western limit of Bethune Street, produced a distance of 726.8 feet.

7568—July 21—Authorizing the C.P.R. to construct a spur to the premises of the Columbia Flour Mill Company, Enderby, B.C.

7569—July 22—Approving by-law of the Marconi Wireless Telegraph Company, authorizing the Secretary-Treasurer, H. G. Matthews, to prepare and issue tariffs of tolls.

7570—July 15—Refusing application of the C.P.R. to construct a branch line across Hardisty Street, Fort William.

7571—July 21—Approving location and detail plans of the C.P.R. station, at Mission Junction, B.C.

7572—July 21—Extending until October 6th, 1909, the time by Order of the Board No. 6803, within which the interlocking plant is to be provided by C.P.R. and G.T.R. at Brampton, Ont.

7573—July 22—Auhorizing the North Regina Rural Telephone Company to carry its wires across tracks of C.N.R. between Section 25, township 17, Range 20 and Section 30, Townishp 17, Range 19, West 2nd Meridian, Saskatchewan.

7574—July 22—Authorizing Fairview Rural Telephone Company to carry its wires across tracks of C.N.R., between Section 1, Township 18, Range 20, and Section 36, Township 17, Range 20, West 2nd Meridian, Saskatchewan.

7575—July 21—Authorizing the Erie Telephone Company to carry its wires across tracks of the Michigan Central Railway at Townsend Station, Ont.

7576—July 21—Authorizing Kootenay Telephone Company to carry its wires across tracks of C.P.R. at Cranbrook, B.C. mileage 14.23 B.C.

7577—July 22—Authorizing the Commissioner of Railways and Telephones of the Province of Saskatchewan, to carry wires across tracks of C.N.R. at Aylesbury, Sask., Township 23, Range 27, West 2nd Meridian.

7578—July 22—Also at Section 16, Township 23, Range 37, West of 2nd Meridian, Saskatchewan.

7579 and 7580—July 21—Authorizing the Manitoba Government Telephones to carry wires across tracks of C.P.R. at public crossing ¼ mile east of Varcoe Station, and at ½ mile south of Varcoe Station.

7581 to 7583—July 22—Authorizing the Bell Telephone Co., to carry wires across G.T.R. tracks, Ontario Street, Port Hope, Ont., 1 mile east of Moose Creek, Ont, public highway crossing 2½ miles west of Maxville, Ont.

7584—July 22—Authorizing the Vancouver, Victoria & Eastern Railway and Navigation Company to contruct maintain and operate a branch line of railway to connect the main line of V. V. & E. Railway with the International Boundary, near Myncaster, B.C.

7585—July 23—Directing the passenger fares upon the line of the Alberta Railway & Irrigation Co's Railway, shall not exceed three cents per mile; round trip tickets shall be issued and sold by the Company at one-sixth less than the total; railway company shall file Standard Passenger Tariffs carrying this direction into effect. Also publish and file special tariff of freight rates between all stations, on basis that shall not exceed those of the C.P.R., for same or similar distances, and on same or similar commodities, that are or may be put into effect on the line of the C.P.R. between Crows Nest Pass and Coleridge. Also a special tariff of class rates from Lethbridge to all of the Company's stations, which shall not be higher than the tariff in force on C.P.R. from Lethbridge for same or nearest equivalent distances. Also tariffs to be filed and publised within thirty days from July 23rd, 1909. Also to prepare, file and publish tariffs of express rates charged for express traffic on its railway.

7586—July 23—Approving plans of proposed subway of the Michigan Central Railway Company, at Tecumseh Road, Township Sandwich West.

(Continued on Page 157.)

## ELECTROLYTIC CORROSION OF THE BOTTOM OF OIL TANKS AND OF OTHER STRUCTURES.*

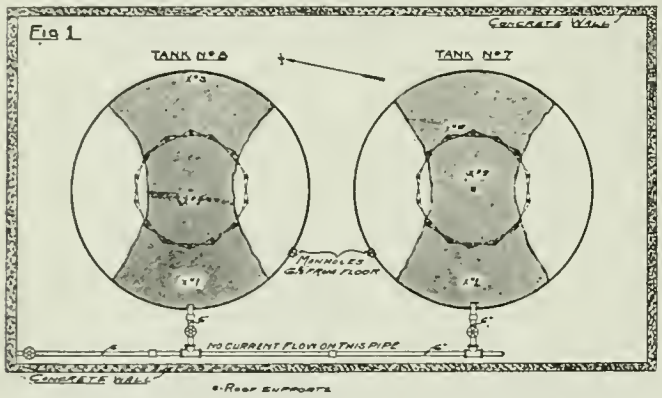
**Adolphus A. Knudson, Electrical Engineer.**

The subject of the corrosion of iron in its broad sense being of wide and growing interest at the present time, any data furnished of special or important features of corrosion discovered in the practical operation of various industries will doubtless be of some value, not only to those engaged in laboratory studies of the question searching for cause and remedy, but those directly concerned who are seeking to avoid the depreciation of costly structures.

In accepting the invitation to prepare a paper for this meeting, the writer has felt a sense of duty as a member of the society to bring before it at this time for discussion, a case of most pronounced corrosion which has recently come under his notice, and which, it seems plain, comes squarely under the head of electro-chemistry.

The case to which we refer is the destructive effects found upon the bottom of oil tanks. Three such tanks have been examined and the the principal subject of this paper. Two of these are located in the gas works of an eastern city and one in the Standard Oil Works of another city.

First, a word in regard to the construction of oil tanks. This being fairly well known, a brief description only is necessary. The many different sizes are made of riveted sheet




steel plates, usually 11 feet by 5 feet and from ¼-inch to ⅜-inch in thickness for the sides and bottoms, and somewhat thinner for the roofs. The roofs are supported in some cases by upright wooden joists from floor to roof, the joists suitably braced. In other cases a steel frame is placed under the roof supported from the sides, similar in appearance to an umbrella frame.

The conditions found in the three tanks examined will now be considered. First, the two tanks at the gas works. These will be considered together, as all the conditions were practically the same in each case, even to the extent of the damage found.

Fig. 1 shows the top view in section of both tanks. These were found numbered 7 and 8 (the same numbers used in the drawing), and will be herein so referred to. These tanks are 35 feet in diameter and 16 feet high, slightly higher at the peak of the roofs. The roofs are supported in this case by perpendicular wooden joists from the floor, as shown by the circle of square dots in the drawing. An intake pipe is located about 6 inches from the bottom of each tank, which is also used as an outlet. These intakes connect to the outside pipe line shown in the drawing.

These tanks which are located on the end of a dock are enclosed within a concrete wall, with concrete foundations; this presumably to prevent oil flowing into the harbor in case of leaks or fire. Both of these tanks were discovered to be leaking. The oil was run off and sediment of a consistency [illegible] removed. The numerous pittings and holes in the bottoms suggested to the men at first, electrolysis due to railway currents, as it was known such currents were flowing through the works. When the writer was called to examine, the first discovery made was the pittings originated at the interior of both tanks, the larger part of such pittings on the inside floor, and tapering downward, many of them terminating in holes through the iron. These holes ranged in size from ¼-inch in diameter to more than 1-inch in several cases.

Plaster casts were taken in a few places on the floors of both tanks, so these effects could be later considered. These casts are herewith submitted for your inspection. Plaster casts, it is well known, are the reverse of holes and pittings. Photographs of these casts have been made and appear in the paper. The shaded portions of Fig. 1 show the location where these pittings and holes were found most numerous. It will be noted they were immediately in line of the intake pipes and spreading out at the opposite sides. The numbers on the casts correspond with the numbers in the drawing, indicating where they were taken. Each of the casts will be briefly explained.

The first three are from Tank No. 7, Fig. 2.

Cast No. 1.—A pitting with a projection near the centre, representing a hole through the metal ¼-inch in diameter. This is the only projection on the casts representing holes

which remained intact; the other broke off when the casts were removed. At the left of this pitting are two white spots which represent holes, where the plaster broke off.

Cast No. 2.—A pitting at the far side nearly through the iron. This was taken about the centre of the tank.

Cast No. 3.—A cluster of pittings representing a fair average of those discovered at the opposite side of the tank. from the intake.

Plaster Casts from Tank No. 8. Cast No. 1.—A group near the intake, which represents a fair average at this point, excepting some holes not far away.

Cast No. 2.—Shows a ridge representing a furrow or channel in the iron bottom 4 inches long, 2½ inches wide, and 6-32-inch at the deepest point, or within 2-32-inch of being through the iron. In the immediate vicinity of this cast were found several holes.

Cast No. 3.—The top broken off, representing a pitting with a hole at the centre. This hole was 1-inch long and ½-inch wide, measuring from the longest and widest parts.

These two tanks have been in service seven years. As they were much needed for storing oil, temporary repairs have been made by filling the pittings and holes with litharge and red lead, but it is probable that new bottoms will soon be placed in them.

Samples of the water obtained from the bottom of two of the gas company's tanks have been analyzed by Dr. Stillman, of Stevens Institute of Technology, Hoboken, N.J., who reports as follows:—

Thos. B. Stillman, M.S., Ph.D., Chemical Engineer,
Hoboken, N.J., October 29th, 1908.

Adolphus A. Knudson, Electrical Engineer,
New York City.

Dear Sir;—The sample of water from bottom of oil tank marked No. 11 contains 1.6 per cent. mineral residue—mostly salts of soda. The sample of water from bottom of oil tank marked No. 7 contains 1.3 per cent. mineral residue—mostly salts of soda.

Both solutions react alkaline.

Respectfully yours,
(Signed) Thos. B. Stillman.

*Read at Fourteenth General Meeting of American Electro-Chemical Society

The oil in Tank No. 7 has been standing about one year, that in No. 11 somewhat longer. This oil is believed to come from Texas.

The bottom of No. 11 was not examined, as it was in use.

### Electrical Conditions.

Tests have been made to ascertain the electrical conditions due to stray railway currents, as possible corrosion from this source, it was thought, might be going on at the underside of these bottoms. Railway currents have been discovered passing through the gas company's yard, mostly going through and leaving the ends of power-house suction pipes placed in river. One of these suction pipes, a 20-inch cast-iron, entered the river quite near these oil tanks. Current flow on this pipe was found passing to the river ranging from 1 to 4 amperes, at times 6 amperes, maximum. The strainers at the end of this pipe have twice been destroyed by electrolysis.

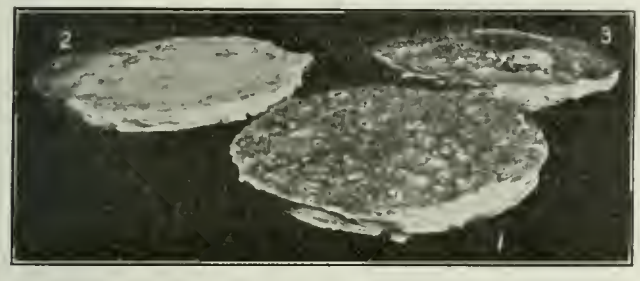



**Fig. 3.**

The voltmeter readings between tanks and river were taken several times during the past year. The tanks have always been found positive to the river. In March, 1908, 2.0 volts maximum was observed. A tank used for tar stands close to these two tanks and is under precisely the same electrical conditions as to stray railway currents, but no corrosion has developed at the bottom, so far as known, either inside or outside. Tests for current flow on the 6-inch pipe connecting with the two tanks shown in drawing, has also been made several times during the past year, but in no case has a flow been detected. There being no other pipes connecting with the tanks, it was concluded that no current was leaving them, notwithstanding the voltmeter indications. Had there been corrosion upon the exterior bottoms as well as upon the interior, with the two forces at work, the life of these tanks would certainly have been much shorter.

### Thermo Electricity.

Tests were also made for thermo-electricity as a possible contributing agent for corrosion. A thermometer observation on a hot day in summer at Tank No. 7 at the interior bottom registered 27.5° Centigrade. At the interior top 39.5° Centigrade, a difference of 12° Centigrade. A millivoltmeter reading between the bottom and top 0.2 millivolt, bottom positive. Shady side of tank positive to sun side 0.15 millivolts. This tank was empty, but the same tests were made on one in use, resulting practically in the same readings, both temperature and electrical. The millivolt test on Tank No. 7 between top and bottom was repeated in winter, when all parts were cold, and with no result. It is a question if these indications of feeble thermo-electricity play any part in the corrosion discovered, but it is mentioned as an item for possible discussion.

### Oil Tank No. 9 in one of the Standard Oil Works.

The pittings and holes being very similar to those discovered in tanks No. 7 and 8, it was not deemed necessary to obtain further casts. At one time it was thought by the manager that the cause of corrosion was due to a certain class of oil stored in the tank, but he found that tanks containing white oils were also similarly affected. In this tank the roof supports were of steel, of the umbrella pattern. A second pipe is used for drawing off the oil. This pipe is called a swing pipe. It has a loose joint at the base and a chain attached at the far end, the pipe being about 20 feet long; the other end of the chain passes through an opening in the roof. The end of the pipe is thus raised or lowered so as to take the oil from near the surface. When we visited this tank a few weeks ago it was cleaned out and one of the side plates removed preparatory to placing in it a new bottom, a contract having been let for that purpose, the former one being so badly corroded it was deemed unfit for further use. The position of the pittings and holes in this tank floor was very similar to those in tanks Nos. 7 and 8, as shown by the drawing, Fig. 1. This tank has been in use thirteen years. The interior sides of all three of these tanks were carefully examined and no sign of corrosion of any kind could be found, in fact, the outline letters and figures on the interior of one of the plates in Tank No. 9, made with chalk or paint when the tank was made thirteen years ago, could be made out, although both letters and figures were upside down as viewed from the floor.

### Danger From Lightning.

If we may digress a little from the main subject, we would like to call attention to the great danger of explosion and fire in oil tanks from lightning by the presence of this chain on the swing pipe. In 1881 the writer called attention to this danger in a paper before the New York Electrical Society, on the subject of "Cause of Explosions in Oil Tanks," such explosions being quite frequent at that time. As an illustration, a small model of a tank was used, and a static machine to produce the electricity; through an opening in the side of the tank the chain could be seen. When discharges were made upon the roof of the tank representing lightning, sparks were observed at nearly every link of the chain inside. As an obvious remedy, we suggested at that time, to substitute a wire rope in place of the chain, which would be a continuous conductor, and if lightning came that way it would pass off silently with no sparks. A letter from the manager of a large oil works in Pennsylvania informed us that they had even gone further than our suggestion, and had not only taken off the chains, but left out the swing pipes in all new tanks that were built, using other means to draw off the oil. It may be, judging from the one discovered in the tank recently examined (No. 9) that there are others with chains in use at the present time, and those in charge of oil works have not realized the danger, and this point may possibly come to their notice. It was a surprise to the writer that something worse than a destroyed bottom has not happened to this tank. The importance of this point, as viewed by the writer, is the excuse for turning aside from the subject for a moment.

### Cause of Corrosion.

In this case of such pronounced corrosion in oil tanks, there must of necessity be definite and pronounced cause. In looking for such cause or causes, the following data have been obtained. It is well known that crude oils contain more or less sulphur. In the purifying process we find it customary to subject such oils to treatment with sulphuric acid, and after that, to caustic soda. The oil is then, after each treatment, washed with water. It is reasonable to suppose that traces of acid or alkali remain with the oil when shipped away. The superintendent of an oil works has informed us that on one occasion 75 barrels of sediment, or "B. S." as it was called, were removed from one of his tanks, which, he said, had a large percentage of caustic soda. When oil is shipped by steamers or lighters on the sea coast, which is often the case, there is more or less leakage, and salt water is added to the mixture, also rain water leakage through the roofs of the tanks. This layer of water which rests upon the bottom of oil tanks contains electrolytes, which are the products of the chemicals referred to, and are distributed over the surface of the iron bottom. Either through impurities of the iron, or from other causes, potential differences obtain, in other words, innumerable small galvanic couples are originated, which, when started, carry on their work of destruction. These galvanic effects, as shown by the plaster casts, indicate growth, some are most minute, as though in infancy, others larger, while some appear to have reached maturity, as shown by the large pittings resulting in holes through the metal in many cases.

A more satisfactory explanation of this cause of corrosion will doubtless be found in the following extracts of letters to the writer, from Prof. Allerton S. Cushman, author of two recent papers on the subject of "Corrosion of Iron," of which you are no doubt familiar. At Dr. Cushman's request, we furnished him with the data of these cases of oil tank corrosion, in which he was much interested, and he has kindly given his opinion, with permission to use same in this paper.

Washington, D.C., October 1st, 1907.

"I have read your letter with care, and I can only say that I am not surprised that the bottom of the oil tanks, in which you are interested, pitted as rapidly as they did. According to the modern theories of corrosion, the electrolysis is not caused so much by outside electrical currents or differences of potential as it is by local difference of potential set up within the metal itself, owing to concentration changes in the distribution of impurities.

"In your tanks, which undoubtedly contained at the bottom a layer of water, in which electrolytes of various kinds were dissolved, you had the ideal conditions for pitting to take place. In my opinion, a fairly liberal application of bichromate would protect the bottoms of such tanks as those in which you are interested."

He also states under date of October 1st, 1908:—

"Since the date of the letters you mention, however, my studies have taught me that the concentration changes in the distribution of the impurities in the iron is only one of the controlling factors in stimulating corrosion. The physical condition of the surface is also important, the slightest indentation, scratch or cut in the surface appears to become positive to the surrounding area, and thus forms a nucleus for a future pit hole. It is probable that in the best practice hereafter attention will have to be paid not only to the method of manufacture of the steel as affecting its chemical constitution, but also to the condition of finish of the surface which is going into use."

Referring to the surface abrasion as a contributing cause for corrosion, it has been noticed by the writer there were many corroded rivet heads on the floors of all three tanks, some partially, but many entirely eaten away. Dr. Cushman's remark as to indentation, scratches, etc., forming a nucleus for future pittings and holes may apply to rivet heads, as well as other parts of a tank bottom, as there is no lack of opportunity for surface abrasion at such points, either in the process of rivetting, men walking over them, or other causes.

### Remedies.

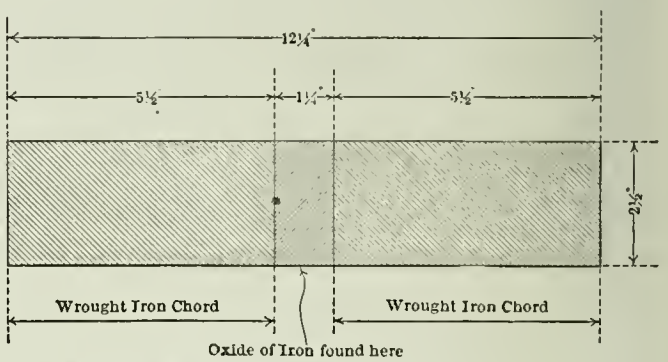
The use of bichromate solution as a protective measure for corrosion of iron has been strongly recommended by Dr. Cushman in his papers and letters, and to myself at a personal interview. His opinions are, it is well known, based upon the results of carefully conducted experiments and we believe worthy of the most favorable consideration. If this method is applied to oil tanks, we think it should be sent into the tanks from the same intakes as the oil, as in such case the remedy would be distributed where most damage occurs, as indicated by the shaded parts of drawing. Fig. 1.

In one instance, as a protection from corrosion, it was proposed by the manager of an oil works to place a layer of concrete upon the floor of tanks. We expressed doubts of this method being effective protection, in view of former experiments by the writer on corrosion of iron in concrete.

Owing to the well known absorption qualities of concrete, water containing electrolytes would naturally pass through it to the iron bottom, probably causing the concrete to crack at points where electrolytic action takes place. Attempts have been made by some to prevent the absorption properties of concrete by incorporating with it certain waterproof materials, but we have no data to present at this time of the efficiency or otherwise of concrete so treated.

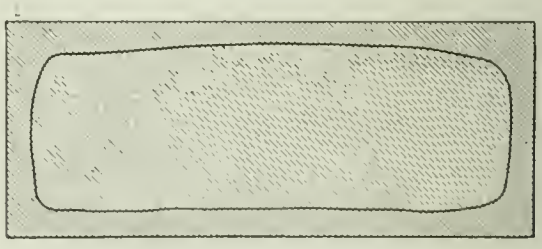
### Corrosion of Other Structures.

Referring to the Rochester steel conduit, Mr. Richard H Gaines has given an interesting account of the corrosion of this water main in a paper before this society at the Albany meeting, April 30th, 1908, printed in the transactions. We have carefully read this account, and we are inclined to believe with those who took part in the discussion that the author's conclusions should not be accepted as final, where he states, page 87 (2), "The corrosion of the Rochester steel conduit was caused by electrolysis, the current for which resulted from chemical processes between water solution in the soil and the metal." While this may be true at some portions of the pipe, we notice that after a long account giving analysis of soils, and of composition of metal, character of coatings, etc., not one statement is made of the methods of measurements by the "electrician from the municipal laboratory," upon whose brief report that "no measurable current could be found with the millivoltmeter from outside sources," it is concluded by Mr. Gaines that no stray currents, past or present, should be considered as a cause for corrosion on this main. Under these circumstances, we do not think this a fair conclusion. Laboratory electricians are not always well equipped either with experience or instruments in locating or tracing stray currents. There are no details of the measurements, or if 24-hour readings were made, the latter to determine if the electrical conditions were the same during the entire 24 hours. It often occurs that the sources of power upon railway lines are changed, operating from a sub-station during the day, and from another part of the city or country at night, from a central station, when totally different results are obtained as to current flow on pipes. It is quite unusual to find pipes as badly corroded as this main is reported, where such corrosion is entirely due to "chemical processes."




Cross section with dimensions of two wrought iron bridge chords, before being damaged by electrolysis. Point St. Bridge, Providence, R.I.

Another point has been noticed in underground electrolysis in an interesting paper before this society, April 30th, 1908, by Prof. Burgess, also at the Albany meeting, entitled "Corrosion of Iron from the Electro-Chemical Standpoint," printed in the transactions. In this paper corrosion of underground structures by straying railway currents is referred to, in which the author seems to question certain testimony that had been given by experts to the effect that a flow of current through the earth had resulted in the deposition of a coat of iron upon pebbles in the earth. I do not know who gave this testimony, but am sure he was correct, as such finds are not unusual.



SECTION OF ONE OF THE WRO'T IRON CHORD MEMBERS OF POINT STREET BRIDGE

Original section of Chord before being affected with electrolysis.

Section of Chord after being affected with electrolysis.

Area of original section 12.375 Sqr. Inches. Area of present section 8.41 Sq'r. Inches. Percent of loss of section 32 Per cent. Area worked out with planimeter.

I have here two pebbles of a number found so coated,

which were taken from the side of a cast-iron pipe which had been practically destroyed by electrolysis from stray railway currents, in the city of Dayton, Ohio. These may possibly be some of the very same pebbles to which Prof. Burgess refers.

These and other samples are submitted for your inspection. The deposition of both iron and lead has often been found by the writer upon pebbles, stones and soils adjacent to pipes which were undergoing electrolysis. We have some samples here personally obtained only yesterday, of stones and pebbles, which lay near a 12-inch steel water pipe which was delivering railway current into the soil, which show more or less of such deposit. This pipe, which is in Edgewater, N.J., is badly corroded. Next to the pipe was found a complete covering of black carbon of about ⅛-inch thick; at some points on the pipe there was a bright, metallic luster; next to the carbon distributed in the soil and upon stones was

**Fig. 4.**

over an inch of iron deposit. Samples of lead deposit are shown, also personally obtained from a lead service pipe in Cleveland, Ohio, which lay in sand. This pipe was so badly injured by electrolysis that about 25 feet had to be replaced with new pipe. These samples appear to be as heavy as an equal amount of lead.

While it is appreciated that the electro deposition of iron is difficult under the most favorable circumstances, these samples so coated are shown as a suggestion that there may be something in the process of underground electrolysis not fully understood.

Another sample of corrosion of iron by stray current process was shown after adjournment, and this data ob-

**Fig. 5.**

tained later. This sample is a mass of oxide of iron 5 inches long by 2 inches deep, and is 1⅛ inches to 1¼ inches thick. It was taken from between two bridge chords which lay 1¼ inches apart, from a bridge that was taken down and replaced by a new bridge, in the city of Providence, R.I. These bridge chords where they lay in soil were badly corroded, and when found were surrounded by a mass of oxide, the same as this sample. Figs. 4 and 5 are photographic reproductions of same; Fig. 6, corrosion at ends of spans. The dimensions of these chords, which were of wrought iron, are given in drawing "A." The comparison of damage with the original size is given in drawing "B." Electrical measurements have been taken upon this bridge for some years past by the writer, who has often predicted damage. The bridge has always been found positive to the soil at the eastern end where this corrosion was discovered. In 1902 corrosion and holes were found upon one of the sheet iron trusses where it entered the soil. The railway power-house was a short distance from this bridge on the west bank of the river. Submarine cables from the power-house were attached to a cable box close to the eastern end of the bridge.

Stray currents have been found on this bridge from July, 1900, up to September, 1903, when they were checked by a change in the railway return conductors, which were placed on poles and the cables abandoned.

This sample and data is an example of what is possible in many bridges in this country.

In conclusion, from the standpoint of the electrical engineer, we are grateful for advice in the solving of electrolysis problems as to cause, effect and remedy in cases where they partly or wholly refer to electro-chemical action. On the

**Fig. 6.**

other hand, personally, we are always willing to furnish information obtained through long practice as to methods for tracing, locating or identifying stray currents causing electrolysis. It would seem, therefore, as Prof. Ganz has stated, that co-operation in important cases between the stray current specialists and the electro-chemist would be desirable, and to that end we have brought this case of oil tank corrosion, as well as other matters, before this society for discussion, believing they are of the widest importance, and particularly refer to electro-chemistry.

## ORDER OF RAILWAY COMMISSIONERS OF CANADA.

(Continued from Page 153.)

7587—July 21—Authorizing the Bell Telephone Company to carry wires across tracks of C.P.R., one mile south of Streetsville Station, Ont.

7588—March 22—Authorizing the C.P.R. to construct railway across eight highways in its authorized grade division between Gull Lake and Carmichael, on its main line, Saskatchewan.

7589—March 22—Authorizing the C.P.R. to construct across nine highways on its main line grade division, Medicine Hat Section, Sask.

7590—March 22—Authorizing the C.P.R. to cross eight highways between Seward and Antelope, Sask.

7591—July 6—Directing the C.P.R. and Kingston & Pembroke Railway Companies to erect and maintain gates at their crossing on Raglan Street Renfrew, Ont. Plan to be submitted to the Board's Engineer on or before August 10th, 1909. Gates to be provided within thirty days of date of approval of plan by Board's Engineer. Gateman to be employed by Railway Companies and be in charge of gates at all times. Twenty per cent. of cost of construction of gates to be paid out of the "Railway Grade Crossing Fund." One-third of wages of men to be paid by Town of Renfrew. The bell at present in use at Raglan Street, be moved to Argyle Street.

7592—July 23—Approving of location and detail plans of the Canadian Northern Ontario Railway Company's proposed station at Sudbury, Ont.

7593—July 22—Authorizing the City of Edmonton to cross with the lines of its electric street railway, the lines of the Edmonton, Yukon & Pacific Railway, Alberta.

7594—July 23—Reinstating for hearing the complaint of F. W. Godsal, Cowley, Alta., against excessive passenger rates on the C.P.R. Steamers between ports of call on the Kootenay and Arrow Lakes, B.C., and in the matter of the Nelson Board of Trade, in support of said complaint.

7595—July 23—Approving local standard passenger tariff, C.R.C. No. 503, of the Canadian Northern Railway, between stations on its branch line between Hudson Bay Junction, Sask. and Pas Mission, Keewatin.

7596—July 24—Rescinding Order of the Board dated June 10th, 1909, which approved amalgamation agreement between C. N. R., and Edmonton & Slave Lake Railway Company.

7597—July 24—Authorizing the Canadian Northern Railway to use the crossing with the Ottawa and Prescott Railway, at mileage 56.6 west from Hawkesbury, for construction purposes only, pending the installation of the interlocking plant provided for in Order No. 7490.

7598—July 22—Approving of plan showing the footbridge proposed to be constructed by the Corporation of Saskatoon over the yard of the Canadian Northern Railway, at Twentieth Street.

7599—July 24—Directing the railways subject to the jurisdiction of the Board shall strictly conform to the rules and regulations from time to time approved by Master of Car Builders' Association governing the loading of lumber, logs and stone on flat and open cars.

7600—July 27—Approving of location of the Nipissing Central Railway, from Cobalt to Haileybury, 5.1 miles, through Townships of Buck, Coleman, Ont.

7601—July 15—Authorizing the City of Fort William to cross within the lines of its railway tracks of the Canadian Northern Railway at Fredericka Street, Fort William, Ont.

7602—July 23—Directing that the C.P.R. and Canadian Northern Railways publish and file a joint class and commodity tariff of rates on freight traffic in classes 6 to 10, inclusive, of the Canadian Classification, between Edmonton and North Edmonton, and all points on C.P.R., south and including Red Deer, east of and including Daysland and Tees, and east and west of Calgary and McLeod via Strathcona Junction, on basis of one per cent per hundred pounds over and above the class and commodity rates of the C.P.R. to or from Strathcona, and rescinding Order No. 6835, April 6th, 1909, issued in connection with the matter of complaint of the Fullerton Lumber and Shingle Company, of Vancouver, B.C.

7603—July 15—Approving revised location of the Fort William Terminal Railway and Bridge Company being from a point on the approved location near Christina Street, thence crossing the Kaministiquia River and across Islands No. 1 and 2.

7604—July 22—Authorizing the G.T.P. Railway Company to use the crossing of Edmonton & Slave Lake Railway Company, in Section 15, Township 55, Range 25, West 4th Meridian, Alberta, for construction purposes only until Nov. 30th, 1909, pending installation of interlocking plant provided for by Order of the Board No. 4672.

7605—July 24—Approving location of C.P.R. Langdon North Branch, mileage 60 to 80, being from a point in Section, 34, Township 31, Range 24, West 4th Meridian, to a point in Section 35, Township 34, Range 25, West 4th Meridian, Alberta.

7606—July 24—Authorizing the Canadian Northern Ontario Railway to construct tracks across the Russell Road Township, Gloucester, Mileage 56.78, west from Hawkesbury.

7607—July 24—Authorizing the Canadian Northern Ontario Railway to construct tracks across Cyrville Road, Township, Gloucester, mileage 55.46 west from Hawkesbury, Ont.

7608—July 24—Authorizing the Canadian Northern Ontario Railway to construct tracks across Concession Road between Concessions 1 and 2, Ottawa Front, Township of Gloucester, mileage 55.22, west from Hawkesbury, Ont.

7609—July 24—Authorizing the C.P.R. to change location of its station at Putman, Ont.

7610—July 24—Authorizing the City of Woodstock, Ont., to lay and maintain a drain under the tracks of the G.T.R., where the same cross Beale Street, Woodstock.

7611—July 24—Authorizing the Water Commissioners of the City of Guelph, Ont., to lay a 24 inch water conduit under track of the C.P.R., Guelph Junction Branch, Township Guelph, Rescinding Order No. 6295, Feb. 19th, 1909.

7612—July 24—Authorizing the Water Commissioners of Guelph, Ont., to lay and maintain a water main across the tracks of the C.P.R., on Metcalfe Street, Guelph, Ont.

7613—July 22—Directing the G.T.R. to file for approval of the Board within thirty days from the date of Order, plans for station to be constructed at or near the point where the Railway Company's line crosses the Town line, between Townships of Clinton and Louth in the County of Lincoln, on its line from the City of Hamilton to the Town of Niagara Falls.

7614—July 23—Directing the C.P.R. to remove by April 1st, 1910, to the satisfaction of the Board's Engineer, compliance with the provisions of Section 230 of the Railway Act, all the obstructions placed by the Company at Coulter's Narrows, District of Muskoka.

7615—July 24—Authorizing the C.P.R. to construct a spur to the premises of Messrs. Johnston & Gill, Kamloops, B.C.

7616—July 24—Authorizing the C.P.R. to construct spur to premises of Peter Lyall & Sons, Lot 188A, Town of Notre Dame de Grace, Quebec.

7617—July 24—Authorizing the C.P.R. to construct two branch lines to the premises of E. N. Heney, Limited, Town De Lorimier, near Angus Station, Quebec.

7618—July 26—Authorizing the C.P.R. to construct a branch line to the premises of I. L. Lafleur, Parish Cote, St. Pierre, Quebec.

7619—July 26—Authorizing the G.T.R. to construct a spur to the premises of J. R. Eaton & Sons, Orillia, Ont.

7620—July 15—Approving location of G. T. P. Railway Company through Fort William, subject to the terms and conditions in an agreement between the G.T.P. Railway and C.P.R., subject to the condition that the G.T.P. Railway shall do as little damage as possible and make full compensation to all persons interested for all damage by them sustained by reason of the railway along any street in the City of Fort William, as provided in the agreement.

7621—July 24—Authorizing the Canadian Northern Ontario Railway Company to operate interlocking plan at crossing the G. T. R. Company's spur line to Edward's Mills, Rockland, Ont.

7622—July 26—Approving construction of eight bridges on the Atlantic, Quebec & Western Railway.

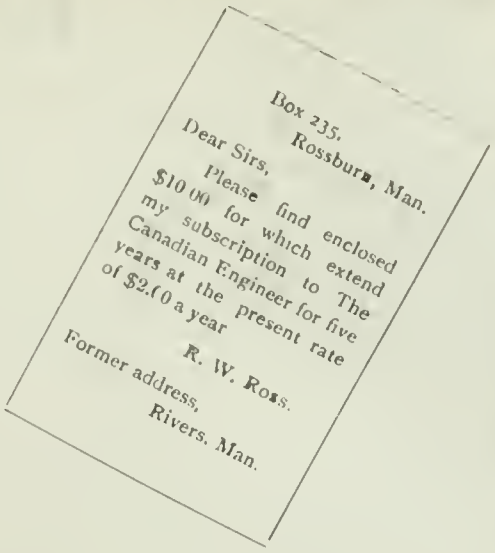
7623—July 24—Authorizing the C.P.R. to construct a spur to the premises of Watt Milling and Feed Company, Parkdale, City of Toronto, Ont.

7624—July 26—Authorizing the Bethel Rural Telephone Company to cross tracks of the C.P.R., 3rd Range S.-W. of Toronto and Sydenham Road, near Concession 3, Lot 211, Proton Township, Ont.

7625—July 26—Authorizing the Ivy-Thornton Mutual Telephone Association to erect wires across tracks of the G.T.R. between Lots 15 and 16, Township of Essa, Ont.

7626 to 7631—July 26—Authorizing the Government of the Province of Alberta to erect wires across the tracks of the C.N.R., one mile west of Chipman, Alberta, at point between Sections 17 and 8, Township 51, Range 11, west 4th Meridian, Alberta; ¼ mile east of Lavey Station, Alberta, at point between Section 1, Township 55, Range 10, and Section 36, Township 54, Range 19, West 4th Meridian, Alberta; ¼ mile east of Mannville, Alberta, at Main Street, Kitscoty, Alberta.

(Continued on Page 160.)


Box 235,
Rossburn, Man.
Dear Sirs,
Please find enclosed $10.00 for which extend my subscription to The Canadian Engineer for five years at the present rate of $2.00 a year
R. W. Ross.
Former address,
Rivers, Man.

# A Generous Response

Already a large number of our old subscribers and some new ones have taken advantage of the offer made to receive new and renewal subscriptions up to August 1st at the old rate of $2.00.

Our Circulation Department report that during the past two or three weeks particularly, the number of renewals for from two to five years has been growing steadily.

Thinking that probably some may have overlooked it we have decided to hold the offer open for another two weeks.

If you want to be sure of the paper for the next few years at the $2.00 rate, please send us by the 15th of August the attached form with your check for any number of years at the old rate.

# Extension Subscription Form

Please find enclosed $.....for which extend my subscription for ..... years at the present rate of $2.00 a year.

This Application should reach us by August 15th, 1909.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of July 31 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price July 30 '08 | Price July 22 '09 | Price July 29 '09 | Sales Week End'd July29 | Price July 30 '08 | Price July 22 '09 | Price July 29 '09 | Sales Week End'd July29 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 2,270,000 | 1,990,000 | 173⅜ 172½ | 185½ | 186 | 79 | 173¾ 173⅜ | 186½ 185½ | 186½ 185½ | 724 |
| Canadian Northern Railway | 2,986.9 | | | 261,200 | 227,800 | | | | | | | | |
| Grand Trunk Railway | 3,536 | 226,000 | 100 | 1,167,357 | 1,112,566 | | | *1st. pref. 105½, 3rd pref. 56⅜, ordinary 23⅜ | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | | | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 76,676 | 71,000 | | | | 176 | 172½ | 217 216½ | 215⅝ 215 | 183 |
| Toronto Street Railway | 114 | 8,000 | 100 | 74,954 | 67,047 | | 104 | | 110 | 106 104½ | 126¾ 126½ | 126¼ 126 | 587 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 158 156½ | | | 171 | 157 | 185½ | | |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## C.P.R. PROFITS, 1908-9.

### Gain in Net Profits Over Last Year is Better Than $1,100,000.

During its year ending June 30th, the C.P.R., according to a preliminary statement just issued, took in $76,313,000, and showed net profits for the year of $22,955,000.

This is an increase in net profits over the year previous of $1,163,206.

The brief statement issued recently shows the earnings for the month of June and the twelve months:—

| | June, 1909. | July 1, 1908, to June 30, 1909. |
|---|---|---|
| Gross earnings | $6,550,153.68 | $76,313,320.96 |
| Working expenses | 4,661,728.89 | 53,357,748.06 |
| Net profits | $1,888,424.79 | $22,955,572.90 |

## SHAWINIGAN POWER COMPANY.

### Earnings for Six Months Make a Satisfactory Showing.

The gros searnings of the Shawinigan Water & Power Company for June show a total of $60,474, as against $56,600 for the corresponding period of 1908. This makes an increase of $3,874 for the month and of $21,870 for the half-year ended June 30th last. The returns for the first six months, with the corresponding figures for 1908, are appended:—

| | 1909. | 1908. |
|---|---|---|
| January | $59,853 | $55,000 |
| February | 58,917 | 55,450 |
| March | 59,031 | 55,520 |
| April | 59,260 | 56,030 |
| May | 60,140 | 56,185 |
| June | 60,474 | 56,600 |
| Total | $356,675 | $334,805 |

## SHORTAGE OF CARS FEARED.

Although there are at present 260,000 idle freight cars in the United States, Canada, and Mexico, according to the reports of the American Railway Association, traffic tonnage has been increasing so rapidly of late that railroad officials are taking steps to prevent possible car shortage this fall. Especial attention is being devoted to the coal traffic.

## RAILWAY EARNINGS ON AMERICAN ROADS.

Total gross earnings of the United States railroads reporting for the three weeks of July are $19,909,497, an increase of 5.2 per cent. over last year and a loss of only 3.6 per cent. compared with two years ago. In the following table is given earnings of United States roads reporting for the three weeks of July and the same roads for a like period in June; also the more complete reports for June and the two preceding months:

Gross Earnings.

| | 1909. | Gain | Per Cent. |
|---|---|---|---|
| July, 3 weeks | $19,909,497 | $ 979,028 | 5.2 |
| June, 3 weeks | 19,875,232 | 1,749,658 | 9.7 |
| June | 54,297,256 | 5,481,375 | 11.2 |
| May | 50,647,562 | 6,755,481 | 15.4 |
| April | 51,657,603 | 5,897,242 | 12.9 |

United States roads reporting for June and included in the classified statement show total gross earnings of $54,297,256, a gain of 11.2 per cent. over last year. Earnings make a better comparison each month, the loss being only 8.7 per cent. compared with June 1907. The statement is printed below:

Gross Earnings.

| | 1909. | Gain | Per Cent. |
|---|---|---|---|
| Trunk Eastern | $6,221,081 | $ 784,830 | 14.4 |
| Trunk Western | 8,233,946 | 460,248 | 5.6 |
| Central Western | 6,166,643 | 214,618 | 3.6 |
| Granger | 7,787,132 | 1,221,756 | 18.6 |
| Southern | 12,200,568 | 855,982 | 7.5 |
| Southwestern | 8,959,133 | 963,370 | 12.0 |
| Pacific | 4,637,753 | 980,570 | 26.8 |
| United States roads | $54,297,256 | 5,481,375 | 11.2 |
| Canadian | 6,354,000 | 896,000 | 16.4 |
| Mexican | 4,795,561 | 236,109 | 5.1 |
| Total | $65,446,807 | $6,613,484 | 11.2 |

### Decrease in Idle Cars.

New York—Idle cars on July 21 were 243,354, a decrease of 16,873 in two weeks.

(Continued From Page 158.)

7632—July 26—Authorizing the Bell Telephone Company to erect its wires across tracks of the G. T.R., at public crossing, Mill Street, Listowel, Ont.

7633 to 7636—July 26—Authorizing the Bell Telephone Co., to erect its wires across tracks of the G.T.R. at public crossing 200 yards north of Norwich Station, Ont.; at public crossing ½ mile west of Norwich Junction Station, Ont.; across tracks of C.P.R. at public crossing, Alma St., Listowel, Ont.; across tracks of C.P.R. at public crossing Inkerman Street, Listowl, Ont.

7637—July 26—Authorizing the Bethel Rural Telephone Company to cross tracks of C.P.R., at public highway crossing, between Ranges 2 and 3, south-west of Toronto and Sydenham Road, at Lot 216, Proton Township, Ont.

7638—July 26—Authorizing the G.T.R. to construct a spur to the premises of the Dain Manufacturing Company, on Lot 22, Concession 5, Humberstone Township, Welland County, Ont.

7639—July 27—Authorizing the C.P.R. to use and operate the following bridges: 1, across St. Maurice River at Gres Falls; 2, across the Gorge, over the St. Maurice River, between Mount Carmel and Shawinigan Falls; 3, across the headrace of the Shawinigan Water & Power Company, at Shawinigan Falls, 4 Great Northern Railway crossing; 5, Station 60, Road Crossing, Toronto Section.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**New Brunswick.**

SHEDIAC.—Tenders will be received by the Shediac Electric and Power Co. at the office of the undersigned at Shediac, N.B., up to the 14th of August, at five o'clock p.m., for the construction of a dam across the Scadouc River at the head of the tide. Plans and specifications for the same can be seen at the office of F. W. Holt, C.E., Room 42, Pugsley Building, at St. John. E. A. Smith, president of company.

**Quebec.**

COOKSHIRE.—Tenders for post-office fittings, Cookshire, P.Q., will be received until 5 p.m., on Friday, August 13th, 1909, for the work mentioned. Napoleon Tessier, Secretary.

CARROLL.—Tenders, marked "Black River Bridge," will be received by the undersigned up to noon Saturday, the 14th of August next, for the construction of a steel bridge on Black River, near Waltham Station, subject to plans and specifications proposed by the Government engineer, Quebec. Address James Coghlan.

MONTREAL.—Tenders, addressed to the undersigned and endorsed (1) "Tender for the construction of fire station," (2) "Tender for the erection of a stable," (3) "Tender for repairs to No. 10 fire station," as the case may be, will be received at the City Clerk's office, City Hall, up to noon, Tuesday, the 10th August next, (1) for the construction of a fire station, on Cedar Street, (2) for the erection of a stable back of No. 4 fire station, Chaboillez Square, and (3) for repairs to No. 10 fire station. L. O. David, City Clerk.

MONTREAL.—Tender for fire hose, or tender for steam fire engine, as the case may be, will be received at the City Clerk's office, City Hall, up to noon, Tuesday, the 10th August next, for the supply of 3,000 feet, more or less, of double jacket cotton fire hose, rubber lined, 2½ inches in diameter, with coupling "Highby Thread," to be subjected to a test if the committee so desires, and for one steam fire engine of a capacity of 1,000 imperial gallons per minute. L. O. David, City Clerk.

MONTREAL.—Tender for crushed stone will be received at this office until sixteen o'clock on Monday, the 9th of August, 1909. Specifications and form of tender can be obtained at the office of the Superintending Engineer of the Quebec Canals, No. 2 Place d'Armes, Montreal, on and after Friday, the 30th of July, 1909. L. K. Jones.

MONTREAL.—Tenders, addressed to the undersigned and endorsed, "Works at the St. Lawrence Market," will be received at the office of the City Clerk, City Hall, until noon, Wednesday, the 11th August instant, for works to be performed to the roof on the St. Lawrence Market. L. O. David, City Clerk.

QUEBEC.—Tenders for electric light wiring and fittings for Postal Station "D," Point St. Charles, Montreal, will be received until 5 p.m. on Tuesday, August 10th, 1909, for the work mentioned. Plans and specification to be seen on application to Mr. Alphonse Piche, Supt. Architect, 52 Victoria Square, Montreal, and at the Department of Public Works, Ottawa. Napoleon Tessier.

**Ontario.**

NIAGARA FALLS.—Proposals for Boulevard Construction, will be received until Wednesday, August 11th, at noon, for the construction of macadam roadway, drainage and culverts of section No. 1A, of the Niagara Fall Boulevard. John H. Jackson.

KINGSTON.—Tenders will be received at the office of County Clerk, Court House, Kingston, up to Wednesday, the 11th day of August at 12 o'clock noon, for the plumbing work, etc., required in improving the sanitary condition of county gaol, as per former advertisement, with some additional work as approved by committee on county property. All of the above work to be completed before January 1st, 1910. John Purdy, Chairman; J. W. Bradshaw, County Clerk.

OTTAWA.—Tenders will be received up to August 15 for the furnishing of iron posts for use on the survey of Dominion lands. P. G. Keyes, secretary, Department of the Interior.

OTTAWA.—Tenders will be received up to August 15th, for supplying the lubricating oils required by the Department of Marine and Fisheries for three years. G. J. Desbarats, acting Deputy-Minister of Marine and Fisheries.

TORONTO.—Tenders will be received until August 17th, 1909, for asphalt pavements, bitulithic pavements, concrete pavements, concrete curbs, concrete walks and sewers. Joseph Oliver, Mayor.

TORONTO.—Tenders will be received up till Friday, August 13th, for the various trades required in the erection of a branch building for the Metropolitan Bank at Queen and Lansdowne, Parkdale. Darling & Pearson, 2 Leader Lane, Toronto.

TORONTO.—Tender for works, addressed to the Hon. J. O. Reaume, Minister Public Works, Ontario, for the erection of a boat house in Belleville, addition to the boiler house Normal School, Toronto, and painting of the Parliament Buildings and Osgoode Hall, and for cement walks on the grounds of Osgoode Hall, Toronto, will be received at this department until noon of Monday, August 9th, 1909.

WHITBY.—Tender for electric light fixtures, etc., for the Public Building, Whitby, Ont., will be received until 5 p.m., on Friday, August 13th, 1909, for the work mentioned. Napoleon Tessier.

**Manitoba.**

EMERSON.—Tender for hot water heating apparatus, Public Building, Emerson, Man., will be received until 5 p.m., on Friday, August 13th, 1909, for the work mentioned. Napoleon Tessier.

WINNIPEG.—Tenders, addressed to the Chairman Board of Control, for furnishing and delivering the following electrical supplies, will be received at the office of the undersigned up to 11 a.m., on Wednesday, August 11th, 1909, namely:—20,000 ½ x 12-inch carbons, 50 alternating current series enclosed arc-lamps, 50 absolute cut-outs. M. Peterson, Secretary.

WINNIPEG.—Tenders, addressed to the Chairman, Board of Control, will be received at the office of the undersigned up to 11 a.m., Monday, August 16th, 1909, for the supply of standard 56-lb. new or relaying rails, with fastenings (angle bars preferred), as follows:—60 tons rails (2,240 pounds), 2½ tons 5½-inch x 9-16-inch spikes, and ½ ton ¾-inch x 3½-inch bolts. M. Peterson.

**Saskatchewan.**

WATROUS.—Tenders will be received by the undersigned up to 6 p.m., August 10th, 1909, for the erection and completion of a four-room brick school building in the village of Watrous. Nicolaus Grest.

**British Columbia.**

VANCOUVER.—Tenders will be received by the undersigned up to noon of Monday, September 6th for the grading and bridging of the Alberni branch from the 108th mile to Alberni (27½ miles) according to plans and specifications to be seen on and after August 7th, at the office of Mr. Bainbridge, Division Engineer E. & N. Railway, Victoria, and Mr. H. J. Cambie, Chief Engineer, E. & N. Railway, Vancouver. R. Marpole, Vice-President.

VICTORIA.—Tender for schoolhouse will be received by the Hon. the Minister of Public Works up to and including Monday, the 16th day of August, 1909, for the erection and completion of a small one-room framed schoolhouse at Parsons Hill, in the Chilliwack Electoral district. F. C. Gamble.

VICTORIA.—Tenders addressed to the undersigned from whom copies of the specifiactions may be obtained, will be received up till 4 p.m. on Monday the 16th day of August, 1909, for the supplying of cast iron water pipe, pig lead, gate valves. W. W. Northcott, purchasing agent.

## CONTRACTS AWARDED.

**New Brunswick.**

AROOSTOOK JUNCTION.—Tenders have been accepted for the erection of railway buildings at Aroostook Junction, the new divisional point of the Canadian Pacific Railway. J. H. Hague, of St. John, will construct a six-stall engine-house, two double cottages, and a turntable foundation. H. Post, of Woodstock, will erect a boarding-house and bunk quarters, while the C.P.R. will build the freight shed itself.

**Ontario.**

WILLIAMSTON.—Tenders were received for the erection of a new bridge over Rombough's Creek. The tender of A. D. Loynachan for a bridge, with stone abutments, 16 feet span, four-inch cedar covering and one and a half inch gas pipe railing, for $400, was accepted.

PETROLEA.—Tenders for the construction of bridges and walks were opened and prices were as follows: Bridges—Petrolea Bridge Co., $3,645; Alfred Kirkpatrick, $3,744; *Robt. Clark & Son, $3,625; Thomas Grace, Sarnia, $3,945. For Walks—Forest City Paving Co., 9⅞ cents per square foot. *J. & J. Kerr, walks, per square foot, 8¾ cents; crossings, 11½ cents; curbing, per running foot, 10 cents; walks and bridge section, 18 cents; grading, $180. Geo. W. Conebear, Chatham—Walks, 10½ cents; crossings, 15 cents; curbing, 20 cents per cubic foot; Henry Walton, of Sarnia—Walks, 9¾ cents; crossings, 11 cents; curbing, where attached to walks, 15 cents. Thomas Grace—Walks, 9¼ cents; crossings, 11¼ cents; wall on Main Street, 25 cents per cubic foot. *Successful tenderer.

**Alberta.**

EDMONTON.—The Carter-Halls-Adlinger Co. are the successful tenderers for the construction of the Grand Trunk Pacific roundhouse and machine shop at Edmonton at around the $75,000 mark.

**British Columbia.**

VICTORIA.—The city has accepted the offer of H. W. E. Canavan of crushed rock delivered at any point within the city at $1.80 per cubic yard. The city will give him the right to erect bunkers on the city wharf at the foot of Herald Street free of charge for the delivery of the rock from scows.

## LIGHT, HEAT, AND POWER.

**Ontario.**

WINGHAM.—On July 26th the citizens voted to appoint commissioners to manage the electric light plant.

HANNON.—Muralt & Company, sub-contractors for the Hydro-Electric Power line have commenced erecting towers. They are working west from Rymal station to the escarpment at Dundas.

DUNDAS. — The transformer station of the Cataract Power Company was fired Thursday night by lightning, and completely gutted. The factories there were all idle yesterday morning as a result of the power being cut off. The damage to the transformer station is placed at $45,000, as most of the machinery is irretrievably ruined.

**British Columbia.**

LADYSMITH.—This city has given a contract for an electric light plant to the Canadian Westinghouse Company, Ltd., for a complete installation consisting of a 115 k.w. 3-phase 60 cycles 2,200 volt generator 10 k.w. each. Potts compound 12 × 18 × 14 Tivill regulator switchboards boiler 72 × 18 C.H.R.T. pumps rejector heater, etc. etc. Power house, foundations, pole line and transformers, street lights, etc., complete and installed. The whole will be a most complete and up-to-date plant, second to none on the Coast for its size, and will be erected under the supervision of Mr. George M. Turner, city electrical engineer.

**Foreign.**

KANE, PA.—The American Plate Glass Company is installing a 700 horse-power Westinghouse horizontal gas engine for power purposes, and has also just contracted for a 16-inch by 26-inch twin tandem horizontal Westinghouse engine to be direct-connected to a 400-kilowatt generator.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

SHERBROOKE.—An agreement has been entered into between the C.P.R. and the city of Sherbrooke whereby the railway company agrees to spend at least $130,000 on improvements at Sherbrooke during the next twelve months. These improvements, it is understood, will consist of a new passenger station and freight shed, a roundhouse, and some new sidings.

**Ontario.**

COBALT.—The T. and N.O. has started grading for a new line from Cobalt to Haileybury to relieve the existing passenger congestion between those two points. The intention is to have an electric car system paralleling the railroad, affording a quick and frequent service. Another line, owned by private capitalists, is already in course of construction. The Government road should be in operation this year. There is a report current that the Government will transfer their divisional point from Englehart to Port Cobalt, where yard room is now being sought.

EAST TORONTO.—A party of ten C.N.R. surveyors have for some days been working their way easterly along about half a mile to the north of the town of East Toronto. Rumor credits the engineering corps with trying to locate a line for the N.C.R. between Toronto and Peterboro'. One survey made passes directly through Dentonia Park Farm. After leaving the town the trial lines run about a quarter of a mile north of the G.T.R. for some distance.

## CEMENT—CONCRETE.

**Quebec.**

MONTREAL.—Major Merricks, managing director of the Sydney Cement Works, C.B., was at the Windsor last week, en route for Great Britain. The enterprise was founded for the purpose of making cement out of the slag from the steel furnaces, and success has been so pronounced that the output is now about 500 barrels per day, and as the market is expanding all the time, the company will, it is said, soon be making at least 1,000 barrels daily.

**British Columbia.**

VANCOUVER.—Albert Pike has been given a contract for cement sidewalks to be constructed by the municipality of Oak Bay.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

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AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

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CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

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WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**National Irrigation Congress.**—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

**League of American Municipalities.**—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

## POSITIONS VACANT

Advertisements under this heading, two cents a word.
Displayed $1.50 an inch.

A Position of Instructor in Physics and Engineering at King's College, Windsor, N.S., is open to a Graduate in Mechanical or Electrical Engineering of a Technological School. Apply stating qualifications to

(Rev.) V. E. HARRIS,
Secretary, Board of Governors, K.C.W.
Church of England Institute, Halifax, N.S.


## PERSONAL.

SIR CHARLES RIVERS WILSON, president of G.T.R., is in Canada on a tour of inspection.

MR. O. W. SMITH, C.E., of the firm of Galt & Smith, Toronto, left last Saturday for British Columbia on a business trip.

MR. ALEX. McDOUGALL, formerly of St. Thomas, Ont., has been appointed master mechanic of the C. P. R. shops at Cranbrook, B.C.

MR. L. BRUCE YOUNG, formerly with the Toronto Construction Co. in New Brunswick, is now on bridge work with C. H. Ferguson at Prince Rupert, B.C.

JENS ORTEN-BOUING, hydraulic engineer, has taken into partnership with him Douglas Spencer and P. R. Cobb, and has removed his offices to 9½ Union Court, Old Broad Street, London, E.C.

MESSRS. S. H. AND D. C. FELLOWES have recently formed a partnership, under the name of Fellowes & Fellowes, with offices in the Lawlor Building, Toronto, and are representing a number of large American manufacturers of contractors,, railway and municipal supplies.

## OBITUARY.

Mr. Frank Turner, C.E., of Deer Park, Ont., who died July 29th, 1909, was born in the city of Toronto on April 13th, 1838, and was the eldest son of R. J. Turner (referee in titles). He was educated at the common school and Upper Canada College, and later took up the profession of civil engineer.

He was a member of the commission appointed by the Government in 1887 to examine and report on the feasibility of the Trent Valley Canal, and later was associated in railway construction work in England, South America and Peru.

For three years he was a member of the York County Council, and was past president of the Albany Club.

## MARKET CONDITIONS.

Toronto, August 5th. 1909.

A midsummer hot-weather dulness seems to prevail in many quarters. With the exception of a slight upward change in hard coal and a downward change in retail cement, we find prices of building material unaltered. In felt and other roofing, sewer pipe, and brick, the movement is brisker than in most other lines of building material.

Metals at last show improved steadiness of tone, all along the line, and there is a distinct increase of business, notably in tin, copper, and zinc, while pig-iron is manifesting a little more activity. Structural steel shows some stiffness, too, a result of more assured orders in the United States.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Season over, nothing doing.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags. The consumption in Canada is between three and four million barrels, while the capacity of production of Canadian plants is nearly eight million. Until the consumption increases, prices can hardly be firm. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—We do not quote any change from $13.85 to $14.05 per 100 lbs., but the feeling is much steadier and business more active.

**Detonater Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is better, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—Considerable demand for both Southern and Canadian dimension pine continues; hemlock dull. Prices are rather stiff all along the line. Dressing pine quotes $30 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—More demand during the past few days, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.85 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

(Continued on Page 40.)

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, AUGUST 13th, 1909. No. 7

## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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| Six Months - - | 1.76 | Six Months - - | 2.00 |
| Three Months - | 1.00 | Three Months - | 1.25 |

ADVERTISEMENT RATES ON APPLICATION.

**HEAD OFFICE: 62 Church Street, and Court Street, Toronto**
TELEPHONE, Main 7404.

**Montreal Office:** B33, Board of Trade Building. T. C. Allum, Business and Editorial Representative, Phone M 1001.

**Winnipeg Office:** Room 315, Nanton Building. Phone 8142. G. W. Goodall Business and Editorial Representative.

**London Office:** 225 Outer Temple Strand T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

**NOTICE TO ADVERTISERS**

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

PRINTED AT THE OFFICE OF THE MONETARY TIMES PRINTING CO., LIMITED, TORONTO, CANADA.

TORONTO, CANADA, AUGUST 13, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## THE COST OF ACCIDENTS.

In this issue we give a list of the more serious railway accidents during July.

The list of killed is large and the number of accidents in which injury was done and rolling stock damaged make an aggregate of casualties which is considerably above the average.

Strictly speaking every accident could be avoided by care on the part of some one and it is worthy of note that trespassers were the greatest sufferers. Frequently we hear great complaints against the railways because they will not allow people to take "short cuts" along or across their tracks yet such regulations are undoubtedly in the best interests of the community.

Every accident to the rolling stock of the railway is a direct financial loss and each victim represents an economic drain on the country. To prevent this drain, an avoidable drain, a campaign of caution must be carried on. Many of our steam and electric railways are publishing literature on how to alight from trains, how to board trains, cautions to be regarded and a disseminating information among their employees in regard to protecting themselves and those who might be under their care and direction.

The newspapers may assist the railways in this matter. The municipalities should. Everything that can be done ought to be done to make it hard for accidents to occur. So long as human judgment is fallible accidents will occur but let us reduce them to a minimum.

## A EUROPEAN OFFICE.

Because of the increased editorial and business interest of The Canadian Engineer it has been found necessary to open a European office. This office will be in charge of Mr. T. R. Clougher and is situated at 225 Outer Temple, Strand, London, England. Mr. Clougher will have at his disposal both an editorial and business staff and will be pleased to render assistance to readers and advertisers of The Canadian Engineer.

## THE ADVERTISING PAGES.

One of our good friends said over a year ago. "Why don't you cut out all your advertisements and give us a journal made up of editorial matter only?"

We could not do it if we wanted to and we would not if we could for to-day the advertising pages have an editorial value—a value that is being more and more appreciated. What with display advertisements, and frequent changes of copy an examination of the advertising pages of a technical journal is worth while.

Many new ideas and suggestions may be found in the advertising pages of to-day and the reader who is seeking the newest and best glances through the advertising pages of this journal before spending time on the reading pages.

It is for this reason that the advertising pages have a value to the seller that he cannot always trace. Many advertisements that have made sales were not answered directly. Publicity impressed upon some one that this was an enterprising firm; that they supplied certain

goods and at the proper time their name was submitted.

Reader, buyer and seller have a mutual interest in the advertising pages.

## THE MATTER OF FEES.

Why is it that so many persons requiring engineering advise are adverse to paying a sufficient fee?

As purchasers of supplies, as merchants and in trade generally they expect to give a dollar for a dollars worth and yet when they are seeking expert engineering advise they expect it for nothing.

The engineer has spent much time and money securing the information and acquiring the experience necessary to enable him to handle successfully a particular situation. More than that he will be able to save to his client many times his fee.

It may be true that within the ranks of the engineering profession there are unprincipled men but because of one black sheep, the whole flock should not be condemned. The great majority of engineers are loyal to their clients interests and are worthy of their hire.

A client never thinks of consulting a doctor or lawyer without paying the customary fee, yet engineers are called upon daily and expected to give suggestions on this or that scheme without remuneration. The habit has grown and now the engineer is expected to prepare the preliminary report for little or nothing.

The engineers have in to many cases been to blame for this. Along with free advise there has grown another bad habit—that of under bidding. The world needs the workers and will pay for the work and under bidding will not make more work and in the end it will be the worse for the cheap man.

## EDITORIAL NOTES.

The citizens of Montreal will this year pay to their treasurer one million dollars for water.

* * * *

The Nova Scotia Steel Company's output for July, 1909 was 74,613 tons as against 59,318 tons in July 1908. and 54,580 tons in July 1907.

* * * *

The building permits for Regina, Sask., amounted to $51,300 for July 1909 against $58,165 for July 1908. This makes a total of $413,945 for this year to date against $214,358 for the same period last year.

* * * *

Three important organizations will hold their annual meeting in September.

**Ontario Municipal Association.**

City Hall, Toronto, 1st and 2nd September.

**Union of Saskatchewan Municipalities,**

City Hall, Regina, 8th and 9th September.

**Canadian Independent Telephone Association.**

City Hall, Toronto September 8th.

**We wish to thank our many readers who have during the last few weeks renewed their subscriptions to The Canadian Engineer for two, three, four and five years. We are not so pleased because of the monetary value but because of the confidence and faith they have in this journal, and our ability to produce a better paper.**

## PRECIPITATION FOR JULY.

A marked feature of the month was the excessive precipitation over the Western Provinces, where in many districts the rainfall was as much as three times the normal amount: Qu'Appelle recorded 7.20 inches, Moose Jaw 6.50 inches, Swift Current and Medicine Hat 4.70 inches, and Calgary 4.10 inches. The normal was also exceeded over the larger part of Ontario and especially in Rainy River, Thunder Bay districts, and all the more northern portions of the Province; but a slight deficiency occurred near Lake Erie and in the Ottawa Valley. In Quebec and the Maritime Provinces the departure from average was generally small and in most localities negative. In British Columbia departures from average were mostly in excess.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for the month.

Ten inches of snow is calculated as being the equivalent of one inch of rain.

| Station. | Depth in inches. | Departure from the average of twenty years. |
|---|---|---|
| Calgary, Alta. | 4.10 | +1.39 |
| Edmonton, Alta. | 3.20 | —0.27 |
| Swift Current, Sask. | 4.70 | +2.13 |
| Winnipeg, Man. | 3.80 | +0.68 |
| Port Stanley, Ont. | 1.80 | —1.50 |
| Toronto, Ont. | 3.48 | +0.48 |
| Parry Sound, Ont. | 3.90 | +0.95 |
| Ottawa, Ont. | 2.94 | —0.61 |
| Kingston, Ont. | 3.60 | +0.55 |
| Montreal, Que. | 3.60 | —0.62 |
| Quebec, Que. | 3.40 | —0.83 |
| Chatham, N.B. | 4.40 | +0.37 |
| Halifax, N.S. | 3.60 | —0.25 |
| Victoria, B.C. | 0.90 | +0.52 |
| Kamloops, B.C. | 2.20 | +0.88 |

### Temperature.

The temperature of July was below average over the major portion of the Dominion, the largest negative departures, amounting to 3°, being in the mainland of British Columbia and in the peninsula of Ontario. The average was, however, somewhat exceeded in Manitoba, Alberta, Northeastern Sasatchewan, the Rainy River and Thunder Bay Districts of Ontario, and very locally in Nova Scotia, the largest positive departures reported being 4° at Prince Albert, and 2° at Winnipeg and Minnedosa.

## MONEY TALKS.

### A FEW MORE KINDLY EXPRESSIONS OF OPINION.

The Publishers,
Canadian Engineer,
Toronto.

Dear Sirs;—

Herein please find enclosed my cheque for six dollars ($6.00) for which kindly extend my subscription to your paper for three years at the present rate of $2.00 per year.

I must say that you are giving good value and that the Canadian Engineer is all right in every sense of the word, and that I would not be without it.

Wishing you every success, believe me,

Faithfully yours,

(Signed) David W. Mill,
Provincial Land Surveyor.

Maria, P.Q., August 4th, 1909.

* * * *

The Canadian Engineer,
Toronto.

Dear Sirs;—

Enclosed find ten dollars ($10.00) for which kindly renew my paper for five years and acknowledge,

Yours truly,

(Signed) B. B. Tucker.

New York & Ontario Power Co.,
Waddington, N.Y., July 30th, 1909.

## WESTERN CANADA IRRIGATION CONVENTION.

The third annual convention of the Western Canada Irrigation Convention was held at Lethbridge, Alta., August 5th and 6th.

Next year they will meet at Kamloops, B.C.; for 1909-10 the following officers were elected: Hon. President, His Honor Lieutenant-Governor Dunsmuir; president, Hon. J. F. Fulton; first vice-president, J. S. Dennis; second vice-president, A. M. Grace; treasurer, C. W. Hallamor, Kamloops; executive committee, W. C. Richardo, R. B. Bennett, Calgary, Alta.; W. M. Fairfield, Lethbridge, Alta.; J. T. Robinson, E. B. Knight, Vernon, B.C.; A. E. Meighen and C. W. Peterson, Calgary. A permanent secretary will be appointed by the executive.

Among the delegates to the convention were:—

H. G. Burrows, Calgary Horticultural Society; D. J. Whitney, W. O. Hutton, Lethbridge Agricultural Society; C. F. P. Conybeare, Lethbridge Board of Trade; H. A. Suggitt, Coaldale; George W. Green, Raymond; C. W. Rowley, Calgary; William Henderson, Lethbridge; Mayor A. M. Grace, Medicine Hat, South Alberta Land Company; W. H. Fairfield, Lethbridge, Superintendent Experimental Farm; G. O. Kerr, Coaldale; W. C. McKillican, Calgary, Government Seed Department; M. E. Wilson, Minneapolis, Minn.; P. M. Sauder, Calgary; H. W. Campbell, Lincoln, Neb.; H. J. Haffner, Vancouver; G. H. Hutton, Lacombe, Superintendent Experimental Farm; J. C. Strong, East End, Sask.; W. J. Tregillus, Calgary; L. A. Bowes, Calgary, Farmers' Advocate; A. C. Rutherford, Strathcona, Premier of Alberta; George Harcourt, Edmonton; R. Bayntun, Kamloops, B.C.; Ebe B. Knight, Vernon, B.C. (White Valley Irrigation Company); Reg. H. Rogers, Vernon, B.C., Board of Trade; Thomas Calloway, Kamloops Board of Trade; W. B. Fison, Kamloops Fruit Growers' Association; George Lane, Calgary; R. H. Campbell, Ottawa; R. Wm. Pilling, Cardston; W. Hargraves, Kamloops; W. Huckvale, Medicine Hat; John T. Hall, Medicine Hat; R. B. Bennett, M.P.P., Calgary; J. S. Dennis and A. S. Dawson, Calgary, C.P.R. Colonization Company; E. Henderson, Vernon, Coldstream Municipality; W Pearce, Calgary; R. Randolph Bruce, Wilmer, B.C.; Charles W. Peterson, Calgary, C.P.R. Colonization Company; G. M. Hatch, Lethbridge Board of Trade; J. W. Evans and E. Laycock, Raymond Town Council.

President J. S. Dennis, in opening his address, said that he thought such an address should be a small part of the convention and had no formal address to offer. He wished to speak a few words as to the work such an association as the Western Canada Irrigation Association can do.

The subject of irrigation and irrigation development has become a very important matter in southern parts of Alberta, Saskatchewan and British Columbia. Questions relating to the users of the water, those constructing and operating irrigation systems and the general public who benefit by the development, should be discussed.

The law relating to the use of water is the foundation of all irrigation work. It has been a big problem in British Columbia, and as a result of this discussion at Vernon a law has been passed that is very satisfactory. The discussion helped the British Columbia Government very much in passing the law..

### Alberta's Law.

In Alberta fortunately we are not confronted with conditions such as these, for we have without exception the best law relating to water ever passed. During all the years the law has been in operation there has not been a suit in the courts.

Irrigation is a new thing to the people coming to Western Canada, as the settlers who are coming are from the non-irrigated regions of America and Europe.

There are a lot of small questions relating to the use of water that cause a certain amount of trouble. If all portions get together in a convention such as this and come to an understanding, the work of development will not be retarded. He hoped that the work of the association would go on and become a power such as the National Irrigation Congress across the line, which has advanced the subject of education on faulty law, has settled many difficulties and influenced a great deal the policy of the government on irrigation matters.

If irrigation is going to do as he believes it is going to do, we should look forward to this convention being the recognized medium between people and government. Irrigation will have much to do with the permanent improvement and prosperity of the country. This part of the Dominion is much in the eye of the people south of the line, and many of them are coming here. The movement of immigration to Western Canada has been to Alberta and it is going westward to British Columbia, to which many are going now. The best work the convention can do is to devote time and labor to the discussion of matters pertaining to irrigation which ultimately is to do so much for this part of the Dominion. If the convention can disabuse the public mind of certain prejudices regarding irrigation, they will be doing a share in the upbuilding of the country.

Mr. R. H. Campbell, of the Department of Interior, Ottawa, addressed the convention on "The Relation Between Irrigation and Forestry." Mr. Campbell spoke of the increasing interest taken by Hon. Frank Oliver in the various irrigation schemes, and spoke of his attitude toward the conventions. He always welcomed suggestions and was ready to act on them. With regard to the water supply question the Department are very active in the region of Cypress Hills and the Milk River country, taking measurements and gauging the rivers. The western district has been divided into three hydrographic districts—Lethbridge, Calgary, and Maple Creek. Speaking of the preservation of forests on the Eastern Slope of the Rockies, the Department has not been idle providing for fire control and regulating the timber licenses. The reservation in the Cypress Hills will be enlarged. In all matters the results of the convention are good. The Department depends to a large extent on reports of conventions. The convention has the full sympathy of the Department.

Several important recommendations were made, among them one authorizing a permanent secretary. The Governments of Alberta and British Columbia were asked to issue bulletins regarding irrigation, as is done by the Department of Agriculture of the United States. Another resolution called for placing the responsibility for noxious weeds along irrigation ditches on those responsible for the maintenance of the ditches. The fourth called for irrigation experts on agricultural institute affairs.

The Government will be asked to set aside the whole of the Eastern Slope of the Rocky Mountains for a forest preserve in order to save the rivers of Alberta.

The convention urged that the Government and irrigation companies come to a working arrangement for the construction of bridges over the ditches while the case is being settled in the courts. A resolution to the effect that the Agricultural College of Alberta should be located at a point where the necessary area of irrigible land can be included in the college farm, in order that the students may be given instruction in the practice and theory of artificial application of water to crops, was passed unanimously. The British Columbia Government will be urged to establish an agricultural college as soon as possible.

## METHODS OF MAKING ORDINARY EXTENSIONS TO WATER WORKS.

In connection with their recent exhaustive study* of the Boston Water Department, Metcalf & Eddy, Consulting Engineers of that city, sought to determine the general method adopted in making ordinary extensions to water works. Inquiries addressed to large cities throughout the United States show that out of 77 cases extensions were made in 5 by both contract and day labor, while in 24 the work was always done

*Report to Boston Finance Commission.

by contract, and in 48 by day labor. Interesting facts are shown by grouping the results according to the location of the cities as in the accompanying table, from which it appears that in the east usually one-third of the cities do extension work by contract, while in the Central and Western States from one-half to two-thirds of them employ the contract system.

**Methods of Making Waterworks Extensions in Seventy-two Cities Grouped According to Location.**

| Location. | No. of cities which make extensions by contract. | No. of cities which make extensions by day labor. | Percentage by contract. |
|---|---|---|---|
| New England | 3 | 26 | 10 |
| New York, Pennsylvania, New Jersey, Delaware, Maryland and District of Columbia | 5 | 10 | 33 |
| Virginia, Georgia and Florida | 1 | 2 | 33 |
| Ohio, Indiana, Illinois, Michigan and Wisconsin | 5 | 4 | 56 |
| Kentucky and Tennessee | 2 | .. | 100 |
| Missouri and Texas | 2 | 1 | 67 |
| Minnesota, Iowa, Kansas, Nebraska and Colorado | 3 | 3 | 50 |
| Washington, Oregon, Utah and California | 3 | 2 | 60 |
| Total | 24 | 48 | 33 |

## NOTES ON THE SMELTING OF TITANIFEROUS IRON ORES IN THE ELECTRIC FURNACE AT WELLAND, ONT.

By B. F. Haanel, B.Sc.

Early in October, 1908, the Electro-Metals Company, Limited, of Welland, Ont., invited the Mines Branch of the Department of Mines to send a representative to Welland to witness the smelting of titaniferous iron ore in their electric furnace. I was, accordingly, instructed to proceed to Welland and report upon this experimental run.

The furnace used during these experiments was similar in construction and design to that employed at Sault Ste. Marie during the experiments carried on by the Dominion Government in 1906, hence a description is unnecessary.

The ore—which was sent by the Union Pacific Railway from their property in Wyoming—contained as high as 2 per cent. titanic acid ($TiO_2$), and the object of the experimental run was to show that an ore high in titanium could be successfully reduced in the electric furnace.

The principal figures relating to the run are as follows:—

| | |
|---|---|
| Length of run (deducting stoppages) | 22 h. 45 m. |
| Mean volts on furnace— | |
| High tension side | 10,800 |
| Low tension side | 35.6 |
| Mean amperes on high tension side | 25.0 |
| Power factor | 0.91 |
| Power used $\frac{10,800 \times 25 \times 0.91}{746}$ | 329 h.p. |
| Pig iron obtained | 3,317 lbs. |
| Output of pig iron per 1,000 electrical horse-power days | Short tons. 5.040 |
| Electrical horse-power years per ton of pig iron = | 0.543 |

The analyses of the iron ore, charcoal, lime, slag, and pig iron produced have not yet been made by the chemists of the Mines Branch; but some analyses made in the laboratory of the Electro-Metals Co., Limited, of Welland, show that with a charge containing 35 pounds of lime only a trace of iron was found in the slag, and that the iron content of the slag increases with the increase of lime.

In the runs containing 50 pounds of lime the amount of slag produced was very large. In future runs on this ore, however, the amount of lime per charge will be reduced to 25 pounds, which, it is calculated, will greatly reduce the amount of slag.

The lime was only reduced to 35 pounds in runs preceding or after my visit. The charges used during the run witnessed by me were as follows:—

| | Pounds. |
|---|---|
| Ten charges— | |
| Iron ore | 200 |
| Charcoal | 60 |
| Limestone | 50 |
| Three charges— | |
| Iron ore | 200 |
| Charcoal | 65 |
| Limestone | 50 |
| Twenty-two charges— | |
| Iron ore | 200 |
| Charcoal | 70 |
| Limestone | 50 |

Making a total of 35 charges.

Some analyses of the pig iron obtained showed only a trace of titanium.

The output in pig iron per 1,000 horse-power days for this run must not be considered as the best result that can be obtained, as the furnace during the first seven hours of the run operated very badly. To arrive at definite and reliable results as to output the furnace should run continuously for at least three days.

On the completion of the analyses of the ore, lime, pig iron, etc., a full report will be prepared.

## COMPRESSED AIR PRODUCTION AND USE.*

By A. C. Whittome.

The early builders of air compressors must have realized how inefficient their plants were, and therefore they adopted the terms "Mecanical" and "Volumetric" efficiency in order to conceal the fact. Unfortunately the terms have been handed down so that, at the present time, we still hear of such impossible mechanical efficiencies as 92 per cent. to 95 per cent., and volumetric efficiencies to even 99½ per cent. Of course such efficiencies never were and never will be attained in the compression of air; they have only been assumed through neglecting those losses which are absolutely inseparable from what it is, practically, semi-adiabatic compression. They would even be impossible if air could be compressed isothermally.

Of course, latter-day manufacturers are not desirous of hoodwinking their customers, few of whom really believe that the so-called "efficiencies" can actually be attained, but it is difficult to get out of a groove, and whilst everyone is desirous of having a proper basis of comparison established, no one cares to take the first step to establish it. One can sympathize with an agent or manufacturer who does not wish to say that his plant is 30 per cent. to 40 per cent. below the efficiency claimed by a competitor on the old system of comparison. On the other hand, intelligent purchasers of compressors ignore altogether the so-called "efficiencies," and use their own judgment in comparing different types of plant. Still the anomaly exists that, with the consent of all interested parties, machinery is on paper credited with efficiencies which it cannot possibly attain. This paper is written in the hope that a better system of comparison will be adopted for arriving at the efficiency of compressors, so that one type can be properly compared with another type.

When we talk of the "mechanical efficiency" of an electric generator we know just what is meant, viz., the proportion that the power delivered at switch-board is to that shown in the cylinders; why should not a similar result be conveyed

*Paper read before the Transvaal Institute of Mechanical Engineers.

by the "mechanical efficiency" of a compressor? There is rather a tendency to confuse the losses due to (a) the production, and (b) the use of compressed air. These losses should be kept entirely distinct, in the manner in which the inefficiencies of boiler plant, engines, and the plant driven by the engines are separated.

The losses due to the system of compressing air may be divided into several sections, which are covered by the general expression "loss of volumetric and mechanical efficiency." In its accepted sense, as regards compressors, "mechanical efficiency" simply means the proportion that the horse-power shown by the air cards bears to that shown by the steam cards. Thus the percentage of loss of efficiency simply covers the internal friction of the compressor and omits altogether those other mechanical losses which we know must occur. To find the "volumetric efficiency" a measurement is made of the length (on the atmospheric line of a low-pressure card), between the expansion and compression curves, and the percentage that this length bears to the total length of the card shows the "volumetric efficiency;" the effects of clearance and low initial pressure are in a sense allowed for, but the losses due to semi-adiabatic compression, high temperature, and leakage are ignored. It will be readily seen that the least efficient system of compression may easily appear to have the greatest efficiency if such a basis of comparison is accepted. And yet on such absurd premises as these, a comparison is frequently attempted of the efficiencies of plants. Of course, many engineers compare their cards with cards set up on a basis of (a) isothermal compression; (b) the absence of clearance; and (c) the absence of losses between stages, etc. I hope to prove that even this system it not satisfactory. Before proceeding I wish to allude to the great

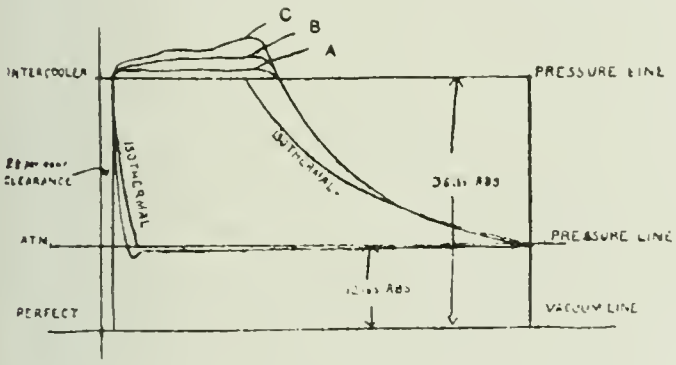



FIG. 1.

difficulty that there is in obtaining full and reliable information on which to base conclusions. Invariably when engines are indicated, there is not sufficient data provided from which to deduce the results. Anyone can obtain air cards by the gross, but it is the exception to find one on which any useful information is noted. In the ordinary course of taking cards it is not necessary that any particular care or trouble should be taken; the engineer only requires the cards so that he may see that valves are in order and that details of that kind are normal. Therefore, for his purpose, it is hardly necessary that even the "scale' 'to which cards are drawn should be given; but, if anything in the nature of efficiency is to be determined, the card might just as well be omitted as the following details:—1. Barometric pressure. 2. (a) Temperature of atmosphere; (b) temperature of low-pressure air inlet; (c) temperature of low-pressure air outlet; (d) temperature of high-pressure inlet; (e) temperature of high-pressure air outlet; (f) temperature of circulating water inlet; (g) temperature of circulating water outlet. [Note.—The latter (f and g) should be taken at the low-pressure cylinder, high-pressure cylinder, and intercooler.] (h) Quantity of circulation water. 3. Pressure at intercooler. 4. Pressure at receiver.

The necessity of obtaining some of these details will be realized on referring to Figs. 1 and 2, which give typical cards for the low-pressure and high-pressure cylinders respectively of a two-stage compressor, three delivery lines being shown on each card for different kinds of outlet valves. Unless the intercooler anl receiver pressures are shown on the card the losses due to high outlet pressure cannot be ascertained. It will be seen that the low-pressure cylinder delivery pressure is considerably above the intercooler pressure, whilst the high-pressure inlet is slightly below intercooler pressure, the respective amounts above and below the intercooler line showing the losses due to the friction of air in pipes and the raising of valves from the seats at outlet and inlet respectively.

In Fig. 3 a combined card is given showing the following:—

| | Pressure. | Temperature. |
|---|---|---|
| Atmospheric | 12 lbs. abs. | 80° F. |
| Intercooler inlet | mean 31 lbs. abs. | 240° F. |
| Intercooler outlet | mean 31 lbs. abs. | 110° F. |
| Receiver inlet | 92 lbs abs. | 230° F. |

An isothermal curve is given for purposes of comparison. The area A M L D and M B C L are measures of

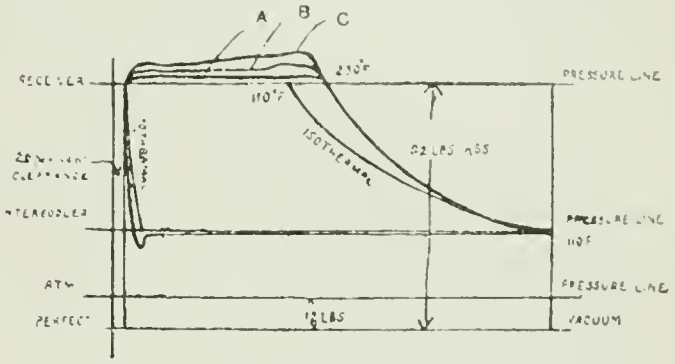



FIG. 2.

the theoretical work of compression; the areas enclosed by A E L F and G H I L show the work actually performed in the two cylinders. Clearances are again taken as being 2½ per cent.. In the theoretical card there is no loss shown between (or in) cylinders. The amount of overlap of the actual cards shows clearly the great loss due to (a) pipe friction, and (b) the excess pressure required to overcome spring loaded valve resistance.

In Fig. 3 the theoretical card is shown based on the assumption that there is no cylinder clearance, thus favoring the compressor. Fig. 4 shows the correct manner of sketching the theoretical cards, and in order that the differences between it and Fig. 3 may be made more apparent, the latter is repeated in the diagram in Fig. 4, and it will be seen that by omitting clearance the theoretical work of one stroke is

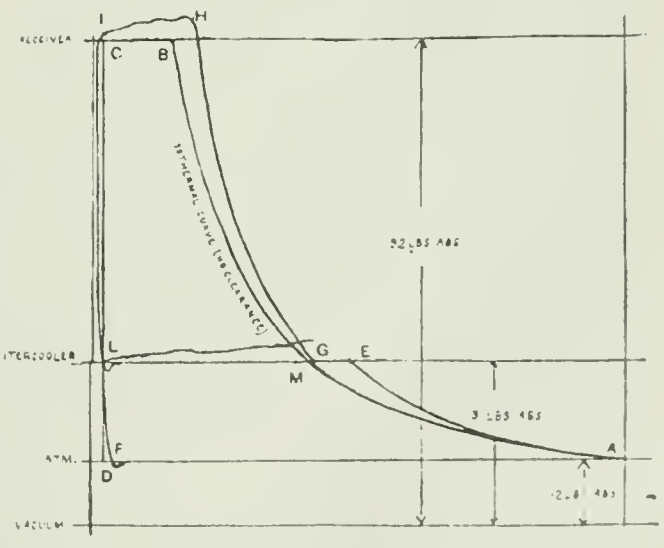



FIG. 3.

made to appear appreciably greater than it really is.

As will be seen from Fig. 5, which combines the work cards of Fig. 3, and the theoretical cards of Fig. 4, the actual losses in comparison are very considerable, the losses being "hatched in." It is my object to show that even the very considerable losses shown in Figs. 3 and 5 are below, rather than above, the actual losses.

It is hardly necessary to state that the inlet lines on compressor cards must be below the atmospheric line (for low-pressure cylinders or interlocker line for high-pressure), even if mechanically opened inlet valves are employed, the friction in pipes, passages, and ports, and the changes of velocity, etc., ensuring some slight drop. If spring-loaded inlet valves are employed this drop below atmospheric pressure will be increased, and the proportion of work performed in drawing air into the cylinder will also rise. And yet how seldom is it that a card is seen on which the pressure at the end of the inlet stroke does not practically coincide with the atmospheric line; in fact, it is nothing unusual to see it shown on the top edge of the atmospheric line. It is frequently claimed that this is due to the admirable system of inlet valves employed on the compressor, and their excellent condition, the fact being ignored that if it needs an excess of pressure on the outside of the cylinder to overcome pipe friction and the resistance of valves, this excess of pressure must also be, to some degree, apparent at the end of the stroke, otherwise air will not flow into the cylinder. The real reason that the pressure rises at atmospheric (and sometimes above it) at the end of the inlet stroke, is that the air has become heated by passing over hot surfaces and by contact with cylinder walls and head, and piston, and the pressure has thereby been increased.

If the temperature of the air rises from 80 degrees Fahrenheit to 150 degrees Fahrenheit, 10.6 lbs. absolute pressure of air will (if the volume remains constant) be raised to 12 lbs. absolute; so that, assuming our 12 lbs. atmospheric pressure has been decreased at inlet to cylinder, by friction, etc., to 10.6 lbs., abs., a rise in temperature from 80 degrees Fahrenheit to 150 degrees Fahrenheit before compression commences would have brought the pressure back to atmospheric once more.

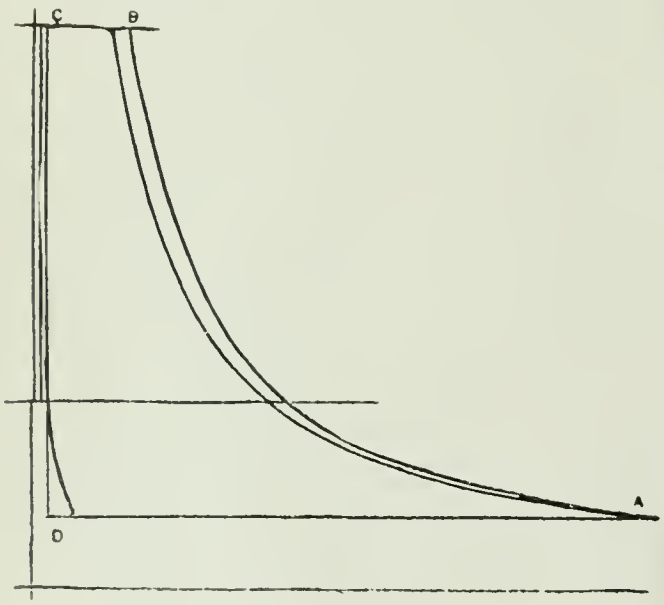



FIG. 4.

Starting, therefore, on the assumption that the air is at atmospheric temperature and pressure if a comparison is made with a theoretical curve, we have the result shown in Figs. 3 and 5, but if we agree that the air must be at a higher temperature than atmospheric, then our isothermal curve should commence below the atmospheric line, at such a point as would give us the equivalent pressure of the air contained in the cylinder had it been at atmospheric temperature. This also explains why it is often, and quite erroneously, assumed that air is compressed practically adiabatically in air compressors. A moment's consideration would assure anyone that adiabatic compression is in practice impossible, as there would be a continuous rise in the final temperature until a delivery temperature greatly in excess of that due to adiabatic compression from atmospheric temperature was reached; this is not so, therefore we have not adiabatic compression, though, because the final temperature is very close to the temperature which would be reached by compressing adiabatically from atmospheric pressure and temperature it appears, on casual consideration, to be approximately adiabatic compression. My point will be realized when I state that with adiabatic compression from 12 lbs. absolute and 84 degrees Fahrenheit temperature to 33.6 lbs. absolute, the final temperature would be 273 degrees Fahrenheit, whilst with an original temperature of 120 degrees Fahrenheit it would be 322 degrees Fahrenheit.

It may seem a small point whether the curve of compression is termed adiabatic or semi-adiabatic, but there is a serious side to the case.

Once it is realized that the cylinder jackets do far more than keep the clinder walls from reaching a temperature too high for efficient lubrication the circulating system will receive more attention, and there will be an immediate increase of efficiency in compressing air.

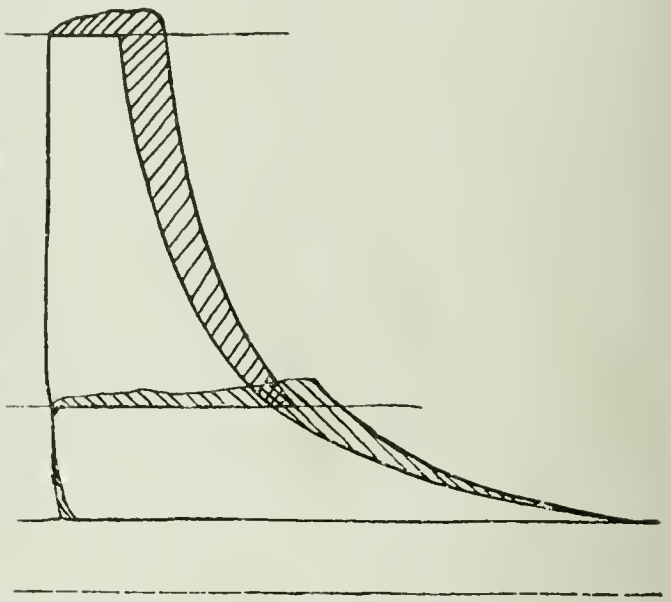


FIG. 5.

Personally I think that if it were considered possible to devote the attention to the inrivirual compressors on the mines which would be devoted to similar machines in big central stations there would be little or no room for central plants. By attention I mean the care in designing the plant,

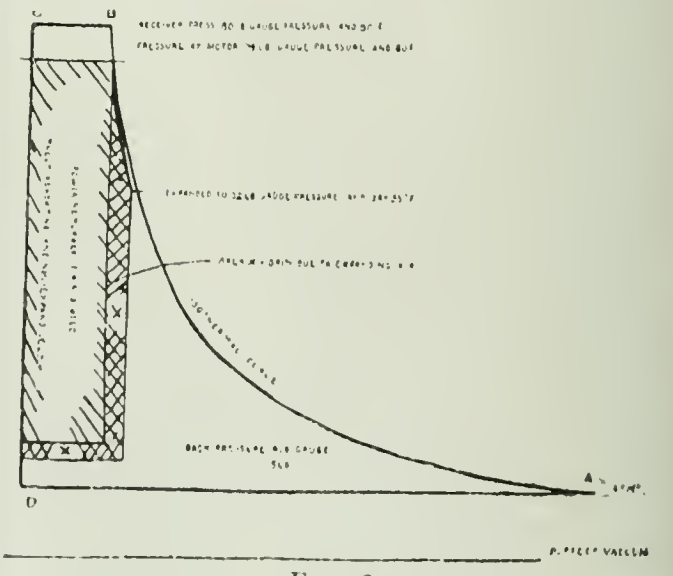



FIG 6

not the supervision of operation; this I do not call into question. One can quite realize that in central stations attention is devoted to every detail which will tend to promote efficiency, and why should this not be so in isolated plants?

I wish to point out an easy and comparatively accurate method of comparing the efficiency of various compressors, or types of compressors.

It is necessary to know: (a) The atmospheric pressure and temperature when the cards were taken; (b) the outlet temperature from high-pressure cylinder; (c) the accurate volume swept per stroke of the low-pressure piston; (d) receiver pressure. In addition to these details a card from the high-pressure air cylinder is required; and cards from the two steam cylinders.

Then the volumetric efficiency can be calculated by the ratio of the weight of air actually delivered by the compressor to the weight of the volume contained in the low-pressure cylinder at atmospheric pressure and temperature. And the mechanical efficiency would be calculated from the ratio between the theoretical work of isothermally compressing the weight of air delivered by the machine from atmospheric pressure to receiver pressure, and the actual work performed in the steam cylinders. Of course, any leakage during the period of high-pressure delivery would not be accounted for, but such a test should only be carried out when the delivery valves were known to be in perfect condition ,and under present conditions, no leakages at all are accounted for.

The use of compressed air is entirely distinct from its generation, and is, of course, attended with very serious losses of energy. The air available for use, after atmospheric temperature (assumed at 80 degrees Fahrenheit) had been reached, is shown in Fig. 6 by the area bounded by A.B.C.D. Of course, if the air were used at a point so near to the com-

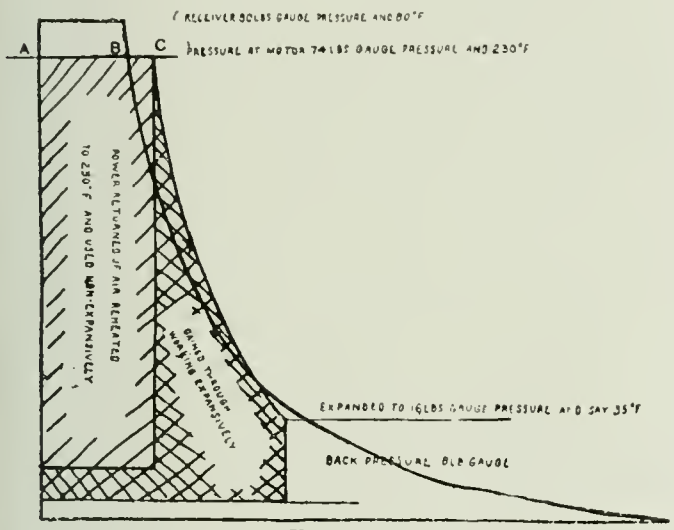



FIG. 7.

pressor that the temperature did not fall to atmospheric, then the amount of energy available would be increased in direct proportion to the higher absolute temperature, but as it is seldom that air can be used before it has fallen to atmospheric temperature, it is not of much practical advantage to consider any other condition. As air can only be slightly expanded if it is not raisel to a fairly high temperature, it is usually only employed practically at high pressure. Fig. 6 shows the proportion of the energy which is used if the air is employed non-expansively at the motor at 80 degrees Fahrenheit, at a pressure of 74 lbs. (allowing 6 lbs. drop for pipe friction) and a back pressure of 8 lbs. above atmosphere. The amount returned is "hatched in" with single lines. Even this comparatively small amount would be reduced by pipe leakages. If the air were expanded to a pressure at which a temperature of 35 degrees Fahrenheit might be reached (allowing for expansion on slightly other than adiabatic lines) it would have a terminal pressure of about 52 gauge. The amount of energy gained due to expansion is shown cross hatched; it will be noted that, as the air is expanded, a lower back pressure is possible. So that, unless the air is reheated, the maximum amount of energy which can be recovered is that shown by the two portions hatched in in Fig. 6. It must be remembered that the area A.B.C.D. represents the energy available for use, not the energy put into the air in the compressor cylinder; Figs. 3 and 6 must be combined in order to compare the energy recoverel wth that expended.

If reheating is adopted Fig. 7 shows what would be the return were the pressure at motor still 74 lbs. gauge and the temperature raised to 230 degrees Fahrenheit (the outlet temperature from compressor high-pressure cylinder). The increase in volume due to reheating is shown by the difference in the lengths of the lines A B and A C, being in direct proportion to the absolute temperatures. The same back pressure as before is assumed if the air is not used expansively, and under those conditions the area "hatched in" with single lines is the measure of the energy returned by the motor. As the temperature is high there should be no excuse for not using the air expansively, and, if it were expanded again until the temperature was in the neighborhood of 35 degrees Fahrenheit, a pressure of 16 lbs. above the atmosphere would be reached. The back pressure would be reduced owing to the lower terminal pressure, and that portion cross hatched in Fig. 7 would show the extra recovery due to using the air expansively when reheated to 230 degrees Fahrenheit. Again, Fig. 7 should be combined with Fig. 3, in order to compare the energy recovered with that put into the air in the compressor cylinder.

The lesson I have attempted to convey by Figs. 6 and 7 is a very bad one, being simply the value of reheating, and I think they show how imperative it is that air should, wherever possible, be reheated. Of course, there are difficulties in the way of reheating. The air must be reheated practically at the point where it is used, otherwise a great portion, if not the whole, of the gain from reheating would have disappeared when the air reached the point at which it was to be used. But, as difficulties only arise in order that engineers shall overcome them, surely there should be some attempt made to solve the difficulty of providing a reheater which can be installed at practically every working face, in such a manner as to avoid the $CO_2$ into the atmosphere. Air at 80 lbs. gauge needs, roughly, ⅛ of a B.T.U. to raise 1 cubic foot 1 degree Fahrenheit in temperature, so that if it were raised from 80 degrees Fahrenheit to 240 degrees Fahrenheit, 20 B.T.U. per lb. would have to be aded to each cubic foot. The addition of this heat would increase its bulk approximately 30 per cent., and if this heat were added with a thermal efficiency of 50 per cent. in the reheater, the increase would be gained at an outlay of not more than 10 per cent. of the heat originally required to produce the air. And the air could also be used expansively down to about 16 lbs. gauge pressure. A petroleum has a calorific value of about 20,000 B.T.U. per lb., and a gallon weighs about 8 lbs., one gallon would add (at 50 per cent. thermal efficiency) the necessary heat to about 4,000 cubic feet of air at 80 lbs. pressure and increase its bulk to about 5,200 cubic feet, an amount equal to nearly 40,000 cubic feet at atmospheric pressure, or sufficient to supply a 3¼ in. rock drill for about five hours' continuous running. But the combustion of one gallon of petroleum would turn about 30 lbs. of $CO_2$ free into the workings, unless it could be caught before passing to the atmosphere. Perhaps our chemical friends could tell us whether this could be managed. A solution of caustic potash will absorb $CO_2$, but I am unable to say whether it could be done in a manner which would prove commercially satisfactory. In any case, if a system could be designed by which the $CO_2$ could be cheaply absorbed, it would prove most profitable, as it would mean the installation of thousands of reheaters at working faces, with enormous increase in the efficiency of the compressed air system.

At the present time it would be almost indecent to leave the subject of compressed air without referring to the potential danger attendant on its use. Compressed air, when its compression is carefully attended to, is practically the safest known means of transmitting power, but under certain conditions it can, as we have recently seen in a most lamentable accident, become an actively dangerous medium. Repeated explosions have shown us that compressed air is not the innocuous mixture that it ought to be. Though we must all regret the fact ,it still remains that explosions in air compressors are becoming more prevalent. Briefly, the causes

(Contineud on Page 192.)

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Aug. 7 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Aug. 6 '08 | Price July 29 '09 | Price Aug. 5 '09 | Sales Week End'd Aug. 5 | Price Aug 6 '08 | Price July 29 '09 | Price Aug. 6 '09 | Sales Week End'd Aug. 6 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,627,000 | 1,470,000 | 172½ 172 | ..... | 186½ 186 | 313 | 172½ 171½ | 186½ 185½ | 187 186¾ | 187 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 195,200 | 174,400 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 832,480 | 794,562 | ..... | ..... | *1st. pref. 105½, 3rd pref. 56⅜, ordinary 23⅜ | | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 78,270 | 70,569 | ..... | ..... | ..... | ..... | 181½ 180¾ | 217 216½ | 215 214 | 183 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,203 | 74,431 | ..... | ..... | 126 | 130 | 105⅝ 105½ | 126¾ 126½ | 125⅝ 125½ | 431 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 167 .... | ..... | 187½ 187 | 90 | | 165½ 185½ | 187½ 187 | 10 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## MONTHLY RAILWAY EARNINGS.

From a glance at the accompanying table of railway earnings for July 1909, with comparisons, it will be observed that a steady increase continues. Relative to the figures for the month of July the increase of $808,000 recorded by the Canadian Pacific represents over sixty per cent. of the total increase for the seven roads, three of which, it will be noticed, are electrical street railways. The returns of every road indicate a consistent increase.

For the first seven months of the year the increase reaches a total of seven and a half millions, for which the Canadian Pacific is largely responsible, the actual figures for that road being $5,742,860. In June the Canadian Pacific gross earnings showed an increase of $896,000, and for the first half of the year an increase of nearly five millions.

| Company | Month of July 1909 | Month of July 1908 | Increase. | January 1 to July 31, 1909 | January 1 to July 31, 1908 | Increase |
|---|---|---|---|---|---|---|
| Canadian Pacific Railway | $ 7,004,000 | $ 6,196,000 | $ 808,000 | $41,972,860 | $36,230,000 | $5,742,860 |
| Canadian Northern Railroad | 843,500 | 728,500 | 115,000 | 4,887,360 | 4,441,000 | 446,300 |
| Grand Trunk Railroad | 3,491,184 | 3,320,114 | 171,070 | 21,731,128 | 21,055,710 | 675,418 |
| Toronto and Northern Ontario | 136,627 | 77,548 | 59,079 | 781,656 | 435,842 | 345,814 |
| Montreal Street | 300,968 | 286,874 | 14,094 | 2,021,760 | 1,917,621 | 104,139 |
| Toronto Street | 292,589 | 266,487 | 26,102 | 2,049,068 | 1,891,047 | 158,021 |
| London Street | 23,692 | 21,460 | 2,232 | 132,657 | 126,559 | 6,098 |
| Totals | $12,092,560 | $10,896,983 | $1,195,577 | $73,576,429 | $66,097,779 | $7,478,650 |

The final move in concentrating the operating staff of the Grand Trunk Pacific at Winnipeg was made this week, when A. A. Tisdale, assistant to the second vice-president and general manager of the road, with his staff, removed from Montreal to Winnipeg.

## EARNINGS OF CANADIAN, UNITED STATES AND MEXICAN ROADS.

### Some Figures for June and July—Complete Returns for Preceding Months.

Total gross earnings of all United States railroads reporting for the four weeks of July are $22,681,295, an increase of 5.9 per cent., compared with the corresponding period last year, and a loss of only 3.6 per cent. compared with July 1907. Railroads continue to make good gains each month. In the following table is given earnings of United States roads reporting for the four weeks of July and the same roads for a like period in June; also the more complete reports for June and the two preceding months:—

| | Gross Earnings 1909 | Gain | Per cent. |
|---|---|---|---|
| July—four weeks | $ 22,681,294 | $ 1,271,582 | 5.9 |
| June—four weeks | 28,107,294 | 2,698,040 | 10.6 |
| June | 120,074,255 | 14,482,065 | 13.6 |
| May | 115,424,132 | 14,677,191 | 14.6 |
| April | 109,663,369 | 11,533,604 | 11.7 |

A number of roads have now reported for June, and total gross earnings of United States roads included are $120,074,255, an increase of 13.6 per cent. over June last year, but a loss of 7.5 per cent. as compared with June 1907. All classes of roads report gains as compared with a year ago, which are very heavy on the Granger, Southern and Southwestern systems; also on the Other Eastern and Pacific lines. The statement is printed below:—

| June— | Gross Earnings 1909 | Gain | Per cent. |
|---|---|---|---|
| Trunk East | $ 26,497,666 | $ 2,804,288 | 11.8 |
| Trunk West | 16,232,482 | 1,574,537 | 10.7 |
| Other Eastern | 5,288,324 | 761,783 | 16.8 |
| Central West | 6,635,661 | 235,115 | 3.7 |
| Granger | 7,787,132 | 1,221,816 | 18.6 |
| Southern | 16,781,036 | 2,441,048 | 17.0 |
| Southwestern | 18,952,505 | 2,596,009 | 15.9 |
| Pacific | 21,899,419 | 2,847,459 | 14.9 |
| United States roads | $120,074,255 | $14,482,065 | 13.6 |
| Canadian | 5,458,000 | 896,000 | 16.4 |
| Mexican | 4,559,452 | 236,109 | 5.2 |
| Total | $131,223,816 | $15,614,174 | 13.5 |

## CANADIAN PACIFIC FINANCES.

### Net Earnings for the Past Fiscal Year Were $22,955,573.

The statistics of the C.P.R. for the fiscal year ending June 30th last were:—

| | |
|---|---|
| Gross earnings | $76,313,321 |
| Working expenses | 53,357,748 |
| Net earnings | 22,955,573 |
| Net earnings of steamships in excess of amounts included in monthly reports | 399,910 |
| Income from other sources | 1,906,578 |
| Total net income | $25,262,061 |
| Deduct fixed charges | 9,427,033 |
| Surplus | $15,835,028 |
| Deduct amount placed to steamship replacement account | 800,000 |
| Deduct contribution to pension fund | 80,000 |
| Net revenue available for dividends | $14,955,028 |
| Surplus for year carried forward after payment of all dividends | $ 3,847,161 |

## CANADIAN PACIFIC RAILWAY FOR JUNE, 1909.

| | |
|---|---|
| Gross earnings | $6,550,154 |
| Working expenses | 4,661,729 |
| Net profits | 1,888,425 |
| June 1908. | |
| Net profits | 1,675,496 |

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWAGE PURIFICATION AND CHEMICAL DEDUCTIONS.

In this issue we take the liberty of reprinting from the English "Surveyor and Municipal and County Engineer" an article by Dr A. Lübbert of Hamburg. This article is of importance as a reply to various criticisms recently made by Dr. Travis of England, in which he attacked the absorption theory as explained by Dr. Dunbar of the Hamburg State Institute of Hygiene. Dr. Travis has recently under the title of "The Hampton Doctrine" attempted to show that bacteria have no part in the purification of sewage as understood in the process of breaking up organic compounds, but that such compounds are only broken up by a slow process of oxidation requiring considerably long periods of time.

Dr. Lübbert naively puts it that "Each walk in life has its peculiar people, and I know an engineer who cannot obtain sufficient food for his gigantic septic tank, and who collects all the possible rubbish from the neighbourhood; but such people are exceptions, and people would generally prefer not to be identified with them."

As a reply to Dr. Travis the article speaks for itself and requires no extra support on our part.

In this issue we also publish the second chapter dealing with the subject of removal of putrescibility. We would ask our readers to consider the matter contained in this article along with the contents of Dr. Lübbert's statement and arguments.

The ordinary busy engineer may ask of what interest is all this acute chemical reasoning to me? Surely it is sufficient to know that a certain percolating filter treating a given volume and strength of sewage, will produce certain results. Although many will be content with final information, there are fortunately others who cannot remain content with the simple knowledge of effect without an understanding of cause. If the knowledge of the chemical changes necessary to change sewage from the organic to the inorganic had in the past been better understood by engineers, the septic tank quackery could never have obtained the position in the sewage world which it has.

The impossibility of adopting any hard and fast lines and accepting any measured method to suit all circumstances of sewage disposal, makes it necessary that the sanitary engineer have a general knowledge of the various chemical and biological changes necessary to sewage purification.

The sanitary engineer has practically to approach every problem of sewage disposal, within certain limits, as a new proposition. He must have an exact knowledge of the various organic and inorganic constituents of the sewage with which he has to deal, and also an exact knowledge of the various processes which are calculated to act or react on these constituents. If he has not this knowledge, he should at once call in a competent chemist to act along with him and advise. Mistakes are made over and over again in taking it for granted that all sewages are of a simple and uniform character, whereas the very opposite is the case.

Apart, however, from the differences which may exist in individual sewages, there are general laws which must apply to the chemical changes which occur in connection with putrescence and the process leading up to it. An understanding of these general laws will so straighten out the whole problem and apparent mystery attending sewage disposal, that the question will occupy a scientific basis quite apart from the basis of guess and chance which has so long ruled all effort in this direction.

The engineer should no longer be in the position of designing a tank or filter and saying it may possibly do so and so. He should in the first instance produce an average analysis of the sewage to be treated and guarantee that after treatment a certain prospective analysis will be obtained. He should also have thoroughly in mind the process and changes which must be effected in order to produce the effluent analysis.

All this requires study and patience. The German appears to have the time and power of application for this study and patience. Shall we allow it that the German is superior to the Saxon in the study of exact science? There can be no doubt that as far as bacteriology is concerned, the German scientists have led the van in research work; and there appears little doubt but that the whole question of sewage disposal is being threshed out by these people in a manner which leaves little to be wished for.

## THE HAMPTON DOCTRINE versus DUNBAR.

**By Dr. A. Lübbert, Hamburg.***

The criticism of the Hampton doctrine which I offered in the issues of this journal for December 4th and 11th, 1908, was replied to at some length by Dr. Travis in the issues for December 18th and 25th, 1908, and January 1st, 1909. Unfortunately, circumstances made it impossible for me to express myself earlier in answer to the reply of Dr. Travis, but I do so now in order to state that his writings entirely fail to cause me to modify the views on the Hampton doctrine which I there expressed. I must maintain what I wrote, word for word, and will therefore be as brief as possible in dealing with Dr. Travis' paper.

In the first place, let me state that my criticism is offered quite independently of the Hamburg Hygienic Institue. It is offered entirely on my own initiative, and is the expression of my own scientific opinion. Owing to an error on the part of the translator it was headed as a contribution from the above Institute, but beyond the fact that the paper had passed through the hands of Prof. Dunbar in his capacity as editor of the Gesundheits-Ingenieur, the article bears only my own imprimatur. In the second place, I am sorry that Dr. Travis takes offence at the tone of my communication, and I assure him that my remarks are not actuated by the least animosity, nor have they been in any of my publications during the thirty years of my activity as a hygienist. Neither am I "desirous of exhibiting a profundity of information," as Travis is kind enough to assume.

According to the Hampton doctrine the separation of the objectionable matter in sewage takes place in three ways:—

(1) By filtration.

(2) The solids in colloidal solution are deposited on the surface of the material or its gelatinous coating, "in

*From the Surveyor, July 23rd, 1909.

virtue of a physical operation," and thus yield the ultra-sludge.

(3) The dissolved organic matters, sulphuretted hydrogen, and volatile bodies are absorbed.

The doctrine also states that the decomposition of these bodies separated from crude sewage is an extremely prolonged operation, lasting for years, and even then a large portion is only partially decomposed. Accordingly, the purification works is only a depôt for receiving and storing the solid matters separated form the liquid. The Hampton doctrine denies that the purification process is in any sense, or under any circumstances, the result of bacterial activity. Micro-organisms simply extend the actual purification process. Hence, according to Travis, the Hampton doctrine affords a rational explanation of biological sewage purifition, a true image of a natural process, which has for its object the fixation of the constituents of the sewage in the soil with the double purpose of supplying an inexhaustible supply of plant food and of preventing pollution of underground waters.

Travis finds the strongest support for his theory in sludge measurements, which yielded the result that the sludge deposited in the filter bed, together with that removed in the preliminary process, gave a total almost equal to the "solids" which were brought to the purification works with the crude sewage. This calculation is said to show that practically no decomposition can have taken place, and the Lawrence experiments which demonstrated the accumulation of difficultly decomposable organic matter in the filters are said to support Travis. He relies, however, especially upon his own experiments with samples of sewage which were allowed to stand in glass vessels until all the pseudo-dissolved solids had settled along with the suspended matters. Even after a protracted period the deposited matters were only slightly reduced, and, on shaking, colloids were washed out into the liquid. This is offered as an explanation of how the colloids of sewage are separated by contact with the surface of the filter material and how they persist as ultra-sludge.

Travis asserts that this new theory is actuated by the necessity of finally disposing of the incompatibility which, in general, has existed between practical experience and theoretical considerations, the situation being characterised by the exhibition of purification works in which the anaërobic and aërobic elements of the beds decomposed everything which they received with the exception of sand, thus causing no accumulation. He states that the hypotheses which have been put forward as to the nature of the sewage purification process have been proved to be false, and it is therefore highly desirable to formulate a theory consistent with practical experience and which shall enable the processes which take place at the various works to be explained.

I have characterised these statements as inapplicable; they result from a mistaken idea of the situation. Each walk in life has its peculiar people, and I know an engineer who cannot obtain sufficient food for his gigantic septic tank, and who collects all the possible rubbish from the neighbourhood; but such cases are exceptions, and people would generally prefer not to be identified with them.

I can only repeat that the "no more sludge dream" has given place to a rude awakening and the amounts of sludge to be dealt with are now known to those concerned. Travis has failed to convert me with his reply. Further, Travis places the sewage colloids in contrast with the other dissolved organic matters, sulphuretted hydrogen, ammonias and volatile products, by saying that the former, in virtue of a physical operation, are deposited as solids and yield ultra-sludge, whilst the latter are absorbed.

This assertion is in direct opposition to the theory of Dunbar, who has shown by numerous experiments that the putrescible substances are absorbed. The colloidal bodies are included in the putrescible substances, and, like all pseudo-dissolved and complex bodies, they are specially adapted to the absorption process. If Travis asks that his view should be recognized he must show where Dunbar's statements are wrong. In the criticism which I offered I laid special stress on the fact that the disappearance of the putrescible matters follows the definite absorption laws, which can be graphically represented as well characterized curves. If the separation of these matters had nothing to do with absorption but were simply due to the formation of gels by surface action, then this would be generally wanting. I am not aware that the formation of gels from colloids by contact with solid bodies or by surface action without absorption, finds exactly the same regular expression as is shown by an absorption curve. Travis leaves the point untouched. Whilst the filtering action of the material of the filter is of moment as regards the suspended solids, the dissolved and pseudo-dissolved solids are absorbed, and in a comparatively short time they are decomposed and mineralised by micro-organisms and higher forms of life. Since the putrescible solids in true solution and those in pseudo-solution experience the same fate and are both absorbed, it does not seem necessary to distinguish between them, and it is sufficient for practical purposes to divide the constituents of sewage into undissolved and dissolved solids, leaving the separation to the filter paper. Travis maintains that he has found sewage colloids which will pass through a dialysing membrane. On the other hand, I maintain that only that portion of the oxidisable organic matter which is retained by such a membrane should be regarded as colloidal, because we have no means of characterizing as colloidal that portion which passes through the membrane. The ultra-microscope leaves us in the lurch, because we cannot recognize the colloids of sewage among the particles which reflect the light, the most heterogeneous substances appearing exactly alike in the ultra-microscope. Hence I have asked, and should very much like to know, how Travis recognizes as such the colloids which pass through the membrane. The finding of so-called albuminoid nitrogen is no proof that colloids are present, for it is known that this analytical process recognizes bodies which are neither of an albuminoid nature nor yet colloidal. This was shown by the experiments of Wanklyn and Chapman. Hence I maintain the standpoint that only that portion of the oxidisable organic matter which is retained by the membrane should be regarded as colloidal. Further, I have stated that much of the undissolved matter in sewage is colloidal in the state of a gel, whilst some consists of matter of a spongy nature, and both these classes of substances possess a large extent of surface and are specially adapted to attract and precipitate upon themselves absorbable substances such as the pseudo-dissolved colloids present in sewage. If the particles thus charged are rubbed, the absorbed colloids on the surfaces become pectinised, and if several particles come into contact they adhere together and the conglomerate thus formed is deposited as soon as it becomes heavy enough. Travis terms this "elegant phraseology," and says that such a process is not compatible with the action of a settling tank; if what I say were correct, the separation of the fine particles and the pseudo-dissolved colloids must be one of the chief characteristics of the settling tank, whereas actually these bodies are comparatively little affected in the settling process. I do not understand how he arrives at this conclusion. Have I made any statement as to the extent to which such a process takes place in a settling tank? The extent to which it takes place depends upon the extent to which friction of the particles occurs and also upon the extent to which absorption processes are faciliated. In my article "On the Theory of Sedimentation and Grimm's Shallow Tanks" (Gesundheits-Ingenieur, 1909, xxxii., p. 80), I have discussed this question, and it is not necessary to repeat my arguments here. As regards the "elegant phraseology," I should like to state that it cannot be ascribed to me. Those who are familiar with the literature on colloids and absorption will be aware that what I have said about the structure of gels and their relationships to absorption is associated with the names of Butuschki, van Bemmelen, Mitscherlich, and others, and that I have borrowed from the important work of Rodewaldt on bodies of a spongy nature. In this litera-

ture Travis will be able to find what is known of colloids and bodies of a spongy nature, and how such bodies behave when they are brought into contact with pseudo-dissolved substances.

After allowing a sample of filtered sewage to settle until it gave no further deposit, and hence contained no pseudo-dissolved colloids, Travis submitted the sample to twenty-four hours' shaking. At the end of this period he again found hydrosols distributed throughout the liquid, and he concludes that the shaking has converted the deposited gels into hydrosols. This, however, involves the assumption that all hydrosols had been deposited as gels, either by contact with solid bodies or the glass walls of the vessel, or by a time reaction.

I stated previously that it is impossible to reconvert a gel into a hydrosol by shaking, a fact which is on the face of it extremely probable since pseudo-dissolved colloids are converted into gels by shaking. I explained the observation of Travis by saying that the pseudo-dissolved colloids had been absorbed by solids and carried down with them. The succeeding shaking operation, which was nothing more than a washing out of the absorbed colloids, again brought the absorbed hydrosols into the liquid.

On the other hand, Travis maintains that absorbed colloids cannot be liberated by washing, and that my view is not correct because, since he used filtered sewage, there were no suspended solids in the samples to absorb the colloids. I must refer Travis to the literature on absorption which has been put into a collective form by Kattein and Lübbert. In this literature he will find that absorbed colloids can easily be removed from the absorbing surface by rinsing. One of the chief characteristics of absorption is that the absorbed body is simply deposited and held on the surface without forming a chemical compound, and that by washing, either with the liquid along with which the absorbed body has been absorbed, or with another solvent, the absorbed body may be separated from the surface and recovered unchanged. Hence, it is not by any means a fable that by shaking—i.e., washing with the supernatant liquid, colloids which had been absorbed by solid bodies and deposited may be again distributed throughout the liquid. Travis asks where the solid bodies were which could absorb the colloids, since he used filtered sewage containing no suspended matter. Here, again, I must refer to the literature on the subject in which similar observations are recorded. In his glass vessels Travis had a deposit of gels which have been derived from the colloids in the sewage. These gels originally were suspended in the liquid, where they had an excellent opportunity of exercising their absorptive powers and attracting pseudo-dissolved colloids, charged with which they were deposited. A portion of the absorbed colloids would become converted into a gel by contact with the absorbing surface, but another portion would remain absorbed as a hydrosol, and by washing—i.e., shaking with the supernatant liquid—this portion would again be transferred to the liquid. Travis attempts to remove my doubts as to the possibility of converting gels into hydrosols by shaking by referring to the experiments of Hardy, who prepared colloids electrically in the gel form and then reconverted these into hydrosols. I do not see what this has to do with my objection, for I have not maintained that it is absolutely impossible to convert a gel into a hydrosol, but only that it is impossible to effect this change by shaking. Or does Travis intend to argue that what may be accomplished by electricity must also be possible of accomplishment by shaking? This argument of Travis appears to me very like someone saying: Electricity decomposes water and therefore shaking must be able to decompose water into hydrogen and oxygen. Travis does not give any instance of anyone having converted gels into hydrosols by shaking. And, moreover, how does Travis estimate colloids? He fills glass vessels with sewage—one vessel was originally empty while two others contained glass beads. One of the latter is shaken while the others are allowed to stand. Then, at various times, the albuminoid nitrogen is estimated in the solution. Before such estimates are regarded as estimations of colloids, it must be shown that with the albuminoid nitrogen process colloids, and colloids only, are estimated. Until this is demonstrated the experiments have no value.

The main fact, however, remains that Travis proves that Dunbar's assumption that the sewage colloids are absorbed is incorrect. It is equally important that Travis brings his views on the rôle played by micro-organisms in to unison with Dunbar's demonstrations.

The Hampton doctrine denies that the purification process is in any sense or under any circumstances the result of bacterial activity, while Dunbar has demonstrated ad oculos that the purifying action of a filter rapidly falls off if its absorptive power becomes exhausted by elimination of micro-organisms. Travis has not replied to this important aspect of the question. Do not micro-organisms play a very important part in the purification process when a filter can be rendered insufficient for its work on the very first day simply by eliminating the micro-organisms, while it will work at its very best for years when micro-organisms are not excluded? Have bacteria only the same importance as the rats in the sewers which occasionally devour something out of the sewage? I cannot imagine how such ideas can be held and maintained without reference to Dunbar's experiments, which prove exactly the opposite.

Th eassertion that the decomposition of the solids separated from the liquid sewage is a process lasting for years is indeed in direct opposition with all experience. If 60 grammes of albumen in a solution of 1 in 250 are discharged daily on to a mature filter the effluent does not contain any albumen. A litre of the effluent contains 200-300 milligrammes of nitric acid (as $N_2O_5$) and also other decomposition products of albumen, such as amido-acids, leucine, tyrosine, etc. This surely demonstrates that very extensive decomposition processes are taking place in the filter, and not that, as Travis believes, the colloidal bodies are being deposited as ultra-sludge. According to the views of Travis we should expect an effluent of pure water and the albumen to be deposited, and to accumulate unchanged on the surface of the material. Only after some years should we expect decomposition products to appear in the effluent, and not very shortly after the filter is started, as actually is the case. Dunbar has further shown that in the effluents from properly-worked filters an amount of mineralised sulphur is found which is exactly equivalent to the amount of organic sulphur present in the crude sewage. When such amounts of organic sulphur are mineralised in passing through the filter it means that very deep-seated decomposition of the colloidal organic matter has taken place. It is well known that the suspended solids block up the filter because they are with difficulty decomposable, and hence efforts should be made to free the sewage from its suspended matter before it is brought on to a filter. It is also well known that about 15 per cent of the solids causing sewage to be turbid are so fine that they are not removed by a mechanical preliminary treatment, so that if these are to be removed chemical precipitation must be adopted. Contact beds which receive chemically-precipitated sewage become unequal to their task just as do beds which receive crude sewage containing all its suspended matters, only their life is a much longer one. This fact shows us that sewage contains mineral substances which do not become completely mineralised. All contact beds, therefore, have to be cleaned at longer or shorter intervals, while with coarse-grained percolating filters blocking is almost excluded, since the film on the material can hardly become so thick as to fill up the interstices between the separate pieces of material. The groundwork of the film is generally formed of bacterial growths, and the products of higher forms of animal and vegetable life. Suspended matters become attached, and when the whole has finally developed its characteristic gelatinous nature, as a result of multitudinous decompositions, it is able to retain salts and to act like a sponge. Thus it is that not inconsiderable amounts of mineral matters which had previously been in solution in the sewage are often found concentrated in the film. It

thus becomes obvious that the film, with its spongy nature, is exceptionally suitable for exercising absorptive powers. All absorbable bodies are deposited on the extensive surface and between the mycelia, and are there decomposed by the enzymes and micro-organisms which have become concentrated in the film, and also by the condensed oxygen. In another place I have shown how the energetic action of this condensed oxygen can be demonstrated, and Dunbar has also discussed the question in his Brussels lecture.

The fact that it is not necessary to wait for years for an exhausted film to regain its absorptive powers is evidence that decomposition does not require years in which to take place. It is only necessary to gradually shorten the periods of rest of a filter to bring these periods to such a minimum as just to yield passable effluents which will just not putrefy. According to circumstances—the character of the sewage, the surface development, ventilation, &c.—these periods of rest will naturally vary in length. As soon as it is proved that between two charges of sewage on to a filter a period of rest must intervene, a period which must be long enough for the filter to regain its absorptive powers, and when it is further proved that these absorptive powers are only regained if micro-organisms are active during the period of rest, this surely means that the intensity of the action of micro-organisms on the filth which has been retained in the filter. How does Travis bring these absolutely proven facts into harmony with his theory?

He says: "The doctrine thus denies that the purification process is, in any sense of the word, or under any circumstances, the result of bacterial action." By "purification process" we can only understand the sum total of the conditions which must exist in order to yield continuously a non-putrescible effluent. In principle, then, Travis adopts the standpoint of Bredtschneider, who has maintained that the purification process would take place equally well and uninterruptedly if no single micro-organism were present in the filter.

Travis has satisfied himself by saying that the hypotheses hitherto advanced to explain the nature of sewage purification have been proved to be false. Why are Dunbar's conclusions false? Where is the error when Dunbar concludes from his experiments: (1) that the putrescible substances, including organic colloids, are absorbed, and (2) that a filter can only continuously yield a satisfactory effluent when exhaustion of its absorbtive powers is prevented by allowing the micro-organisms, &c., time to decompose the absorbed substances? How does Travis invalidates the experiments of Carnwath carried out in the Hamburg Hygienic Institute? It has never been maintained that the absorbed substances are mineralised without leaving any residue, nor that the resulting products are completely washed out by the succeeding charge; on the other hand, it has been stated that undecomposable remains strengthen the gelatinous film. The decomposition is, however, so thorough that the absorbed substances are changed in such a manner as to enable the film to retain absorbable substances from the next charge of sewage.

Two filters, exactly similarly constructed of sterile clinker, were equally charged with sterile solutions of peptone, sewage, or other putrescible liquid. The only difference consisted in supplying one filter (I.) with air rendered sterile by filtration through cotton wool, and other filter (II.) with untreated air containing micro-organisms. In the earlier charges supplied to both filters the putrescible substances were retained, and this retention could be graphically expressed by exactly similar absorption curves. But very soon a difference became evident. After a few charges the absorptive powers of filter I. had become exhausted, and the sewage or other liquid was discharged unchanged. Filter II., however, became matured, the film on the material developed, the effluent continued non-putrescible, and contained the decomposition products of the organic matters supplied to the filter—e.g., the organic sulphur had disappeared and in its place the effluent contained an equivalent amount of mineral sulphur. Could we have a more brilliant refutation of the Hampton doctrine? The above experiment, carried out by Carnwath in Hamburg, has been published, and I have discussed it myself in several articles—e.g., in my controversy with Bredtschneider, "On the Nature of the Action of Oxidation Filters" (Gesundheits-Ingenieur, 1906), and in an article on "Biological Sewage Purification: The Characteristics of the Oxidation Process" (Zeitschrift für Hygiene und Infektionskrankheiten, Vol. lix., 1908.

## SEWAGE DISPOSAL.

### Removal of Putrescibility.

### CHAPTER II.

### The Role of Bacteria and Oxygen.

The chemical changes occuring in sewage in the removal of putrescibility are viz:

(a) The conversion of urea and other nitrogenous matter into $NH_3$, $CO_2$, and water.

(b) Oxidation of $NH_3$ into nitrities, and nitrites into nitrates (by the nitrifying bacteria of the soil and sewage).

(c) The reduction of nitrates into nitrites, thus liberating O, which oxidises organic matter and reforms nitrates, (this is by the denitrifying bacteria).

(d) The conversion of non-nitrogenous matter into $CO_2$, and water.

(e) The conversion of cellulese into $CH_4$, $CO_2$, etc., (by B, butgricus, B, gummis and B, putredinies, etc.)

(According to Lewis and Balfour.)

The average composition of the sewage of a large number of English towns was found by the Rivers Pollution Commission to be as follows:

Average Composition of Sewage of English Towns.

(Parts per 100,000.)

| Classes of Towns. | Total Solids in Solution. | Organic Carbon. | Organic Nitrogen. | Ammonia. | Total Combined Nitrogen. | Suspended Matters. Total. | Organic. | Mineral. | Chlorine. |
|---|---|---|---|---|---|---|---|---|---|
| Midden Towns ..... | 82.4 | 4.181 | 1.975 | 5.435 | 6.451 | 11.54 | 17.81 | 21.20 | 39.11 |
| Water Closet Towns .. | 72.2 | 4.696 | 2.205 | 6.703 | 7.728 | 10.66 | 24.18 | 20.51 | 44.69 |

The above average sample of English sewage will be found to be stronger than most American or Canadian sewages. The strength of a sewage depends upon the amount of dilution, and may be measured by the amount of water supplied per capita. The average water consumption per head in England is about 45 gallons per day. In applying English data this point should be kept in mind. Referring to the above analysis we find that the amount of solids in suspension is about half the amount in solution. The removal of putrescibility has to deal with, not only the solids in solution, but also the other organic impurities, apart from the 60 to 70 per cent. of the matter in suspension, which may be removed by preliminary treatment, such as sedimentation.

The putrescible elements in sewage were first removed by means of land. In 1868, under the auspices of a British Royal Commission, Sir Edward Frankland carried out several laboratory experiments, which may be said to be the basis of the present biological process. Frankland's experiments resulted in the Commission recommending land intermittent filtration. Glass cylinders, open at top and bottom, 6 feet high and 10 inches wide, were used for the experimental work. The filtering material consisted of 3-inch layers of gravel, and surmounted with soils of various degrees of porosity. The filters were dosed intermittently, and most satisfactory results were obtained. Frankland explained the process as being similiar to treating each intermittent dose, drawing in oxygen, which effected the oxidation of the organic com-

pounds, and accounted for the presence of the nitrates and nitrites in the effluents.

Bailey Denton, in 1871, put Frankland's experiments to a practical test at Merthyr Tydvil, and he may be said to be the father of practical land intermittent filtration in England and Scotland. The process, however, received no other explantation than that afforded by the oxidation theory; and although Frankland's experiments may be said to be the basis of the biological methods, it is the systematic and scientifically carried out experiments of the Massachusetts State Board of ealth which deserve the full credit.

Although the Massachusetts "Lawrence" experiments are now historical and familiar to sanitary engineers, a brief summary of some of the principal tests will here be useful, showing the evolution of the present biological system. Ten

$$\frac{1}{200}$$

wooden tanks were used —— of an acre in area. These were provided with effluent pipes leading to the laboratory station, where average samples were taken and the volumes measured. Filter No. 1 had a layer of coarse mortar-sand 5 feet deep. Filter No. 2, very fine white sand; No. 3, peat, with a covering of earth; No. 4, fine river silt or sand; into others, garden soil, mixtures of sand and gravel, loam and clay and sand.

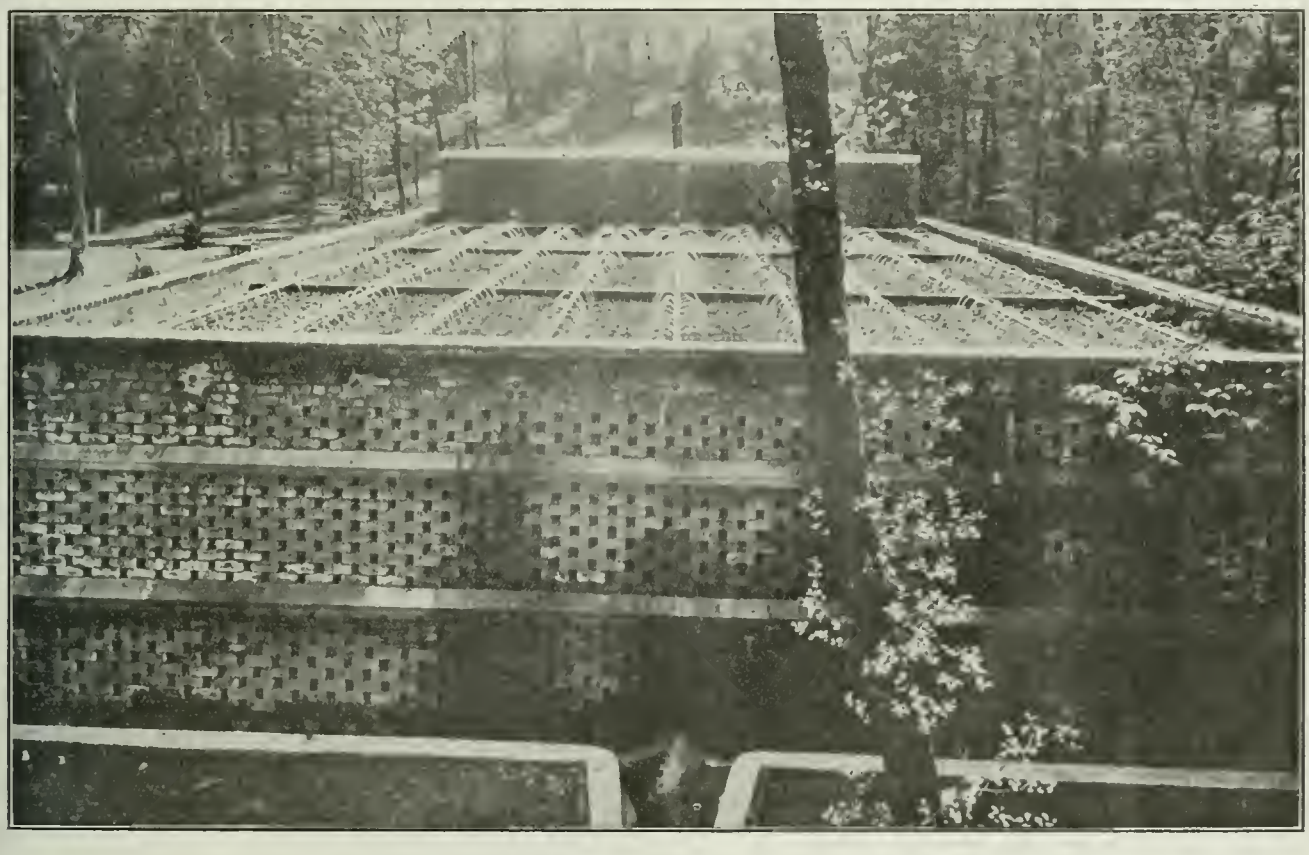
In 1891 a filter was constructed of gravel, about 1 4 m m. in size, and during following years dealt with increasing quantities of sewage from 24,000 to 97,000 gallons per acre per day. The oxygen absorbed was reduced by 80 , and the effluents contained an average of 7.7 parts of nitric acid per 100,000 (2.43 at first and 12.69 later, as the filter matured.)

In 1894 a coarse grained gravel filter was put in operation and dosed at the rate of 13,000 gallons per acre, per day. The filter at times was provided with artificial aeration and was worked at the rate of 350,000 gallons per acre, per day. At this enormous rate a reduction of oxygen absorbed of from 60 to 85 per cent. was obtained.

It may here be pointed out that the reduction of oxygen absorbed by 60 to 65 per cent. renders a sewage effluent non-putrescible.

The results of the above experiments led the Massachusetts Board of Health to adopt land intermittent filtration at many of the towns under their jurisdiction.

We have seen that Frankland assumed that the dissolved organic matters in the sewage were oxidised by the oxygen of the air entering the pores of the filtrate, as the sewage percolated from the surface to the base of the filter. The process of nitrification, however, received further explanation during the years 1877 to 1890, by Schloesing and Munteg, as well as by Warrington and Winogradsky. The action of



**Spray Pipes Fed From Syphon Tank Under Varying Head.**

During the first six years the amount of sewage passing into Filter No. 1 was gradually increased from 53,000 to 123,000 gallons per acre, per day. The effluents contained an average 6.5 parts per 100,000 of nitric acid, and showed a reduction of 87.5 per cent. on the oxygen absorbed figure. The number of bacteria was reduced from 1½ millions to 40,000 per c.c., or a reduction efficiency of 97.3 per cent.

Filter No. 2, containing fine sand, during six years' working, rendered non-putrescible an average of 33,000 gallons of sewage per acre, per day, reducing the oxygen absorbed figure by 95.2 per cent. The effluent contained 6.13 parts of nitric acid per 100,000 and only 550 (sometimes even less than 100) bacteria per c.c. The results of the peat filter were entirely unsatisfactory, proving, as has since been demonstrated by the recent British Royal Commission, that peaty soils are of no use as a sewage filtrate.

the filters was explained in Massachusetts by assuming that the bacteria in the sewage and in the filter directly mineralized the organic matters during the slow flow of the sewage through the filter. This explanation was only a possible one on the assumption that the sewage remained in the filters for three or four days. Purified effluents were obtained, however, in short periods of less than ten minutes. It cannot be assumed that such short periods are sufficient for bacteria to decompose the complex organic compounds found in sewage, in fact that they be oxidised to nitric acid, and organic carbons to carbonic acid, and organic sulphur to sulphuric acid, etc. To quote the exact words of Prof. Dunbar: "It can only be assumed that the dissolved organic matters are first separated from the sewage during its passage through the filter, and are retained in the filter to be decomposed and oxidised by the micro organisms during the succeeding period of test." In support of an explanation, Dunbar has directed experiments to the following three problems. (1)

Mechanical filtration, (2) chemical combination, and (3) absorption.

In the introduction to these articles we endeavored to show that even successive passages through fine filter paper only effected the suspended matter, and that mechanical filtration made an appreciable diminution to the amount of dissolved organic solids. Solutions of albumen heated by mechanical filltration give filtrates containing almost an equal amount of organic matter. "A solution of albumen, with an oxygen absorbed of 9.28 parts per 100,000, when filtered through a bacteria proof Berkefeld filter, yielded a filtrate of which the oxygen absorbed was 8.2 parts per 100,000. Such a filter reduced the oxygen absorbed of a sample of sewage from 10.47 to 17.30 parts per 100,000. The process of filtration did not alter the character of the liquids, for both filtrates were still putrescible. In spite of such results it has recently been persistently maintained that the process of purification is a mechanical one."*

As a result of experiments carried out in connection with the Hamburg State Institute of Hygiene, Dunbar has built up what is termed the absorption theory. This theory accounts for the phenomena, which occurs in a filter, by which the organic matter in solution is retained for the length of time required for the chemical changes to take place. The power of absorption is dependent on the growth of a gelatinous film, which gradually covers the filtering material. This film is mostly composed of bacteria and other low forms of life. As the film becomes thicker, the volume of the pores diminishes, but at the same time the water retaining capacity, within limits, increases, and the purification results also increase. The attainment of this efficiency is generally termed the "maturing process," only by the assumption of the absorption theory, which has been thoroughly and scientifically demonstrated, can the action of a biological filter be understood and explained. It will be readily understood, if this assumption is a correct one, that the life of a filter must depend (a) upon the capability of providing this absorptive scum, (b) the ability of the bacterial decomposition to keep pace with the absorption. An equilibrium between these two factors will provide the greatest efficiency.

In following chapters we will attempt to show how far this equilibrium can be maintained in the case of (a) intermittent land filtration, (b) contact beds, (c) percolating filters.

(To be Continued.)

## WOOD WASTE DECREASING.

The waste wood heap continues to diminish and pass away.

A Massachusetts manufacturer of brushes recently made a discovery in Maine which supplied him with material exactly suited to his purpose. He went to the Pine Tree State to buy wood for the backs of hair brushes and the handles of shaving brushes, and chanced to visit the yards of a spool maker who was using white birch. The spool man took the white part of the wood only, and was throwing away the red hearts. Thousands of cords had been burned or dumped in the lake to be rid of it.

The red hearts were exactly what the brush maker wanted, and at little more than the expense of freight he supplied his factory.

This is typical of the trend of manufacturing. Waste of wood is still great, but it is decreasing. What one factory can not use, another turns to profit. Formerly mills threw away half the forest-tops left in the woods, sawdust dumped in streams to pollute them and destroy fish, slabs burned in perpetual bonfires, and defective logs and low-grade lumber abandoned as not worth moving.

This policy does not generally prevail now. Some mills have put in machinery to work up their own by-products, others sell their waste to manufacturers who can use it, as in the case cited in Maine. The properties and uses of woods are now subjects of careful investigation, and the problem of turning to account the odds and ends and the by-products is brought more to the front now than formerly.

The United States Forest Service has taken up this study in a comprehensive and systematic way. Investigations of the woods of particular states are being conducted, usually in co-operation with the states concerned. The plan, when fully carried out, will include every commercial wood in the United States, not fewer than 200 species. The properties of each will be investigated, its hardness, toughness, elasticity, durability, weight, fuel value, size of tree, regions where grown, the common names by which it is known in different localities, and other matters of this kind. A history of the wood's uses in the past will be given, and an account of present uses; together with suggestions for a wider range of usefulness in the future by pointing out in what capacities it will serve best and be most valuable.

## WATER TANK CAUSES COLLAPSE OF BUILDING

The six-storey brick warehouse owned by the J. C. Wilson Paper Company, of Montreal, on McDermot Avenue, Winnipeg, was wrecked July 26th, under the weight of an 88-ton fire tank, which was placed on the roof six months ago. The damage will amount to about $30,000.

The building was of mill construction design, the outside walls of brick, two bricks thick, and the partitions, floors, posts and stringers of wood.

The walls were 21 inches thick at the basement, tapering

to 17 inches in the centre, and 13 inches at the top. The weight of the tank filled was 175,000 pounds.

The water tank on the top of the building was supported on four legs resting on steel girders, and was directly over the corner of the building which fell. Three of the legs rested upon the walls and the fourth on a column which still remains standing. Persons who witnessed the accident, state that the huge tank dropped through two floors before breaking,

The collapse was doubtless due to the fact that the girders of the building were not properly anchored to the walls, and that the wall brackets were not imbedded to a sufficient depth in the walls to support the timbers.

One noticeable thing was that the rear wall was cut off square at a row of windows.

* Dunbar "Principles of Sewage Disposal."

## RAILWAY ACCIDENTS IN CANADA DURING JULY.

The Interstate Commerce Commission of the United States publish regular returns giving the number and causes of accidents in that country. The Canadian statistics are published when about a year old, and, although, perhaps more complete than the list we are able to give, yet because of the delay it has lost interest. The following table gives fifty-one killed during the month against thirty-one injured. It is likely the proportion of injured would be larger if the list were complete.

No notable accidents occurred, and over one-third of those killed were persons trespassing on the railway track.

The following table gives the list of those killed or injured by steam roads.

| Character of Accident. | Passengers. Killed. | Passengers. Injured. | Employes. Killed. | Employes. Injured. | Others. Killed. | Others. Injured. | Total. Killed. | Total. Injured. |
|---|---|---|---|---|---|---|---|---|
| Derailment | 1 | 11 | 3 | 1 | .. | .. | 4 | 12 |
| While Shunting | .. | .. | 3 | 2 | .. | .. | 3 | 2 |
| Highway Crossings | .. | .. | .. | .. | 4 | 1 | 4 | 1 |
| Falling Off Freight Cars | 1 | .. | 2 | 2 | .. | .. | 3 | 2 |
| Trespassing | .. | .. | .. | .. | 17 | 4 | 17 | 4 |
| Body Found on Track | . | .. | .. | .. | .. | 1 | .. | 1 |
| Pitch-in With Hand Car | .. | .. | 3 | 2 | .. | .. | 3 | 2 |
| Passengers Falling Off Train | 1 | 1 | .. | .. | .. | .. | 1 | 1 |
| Working on Track | .. | .. | 6 | 1 | .. | .. | 6 | 1 |
| Collision, Rear End | .. | .. | 1 | 1 | .. | .. | 1 | 1 |
| Attempt to Get on Moving Train | .. | .. | 3 | .. | .. | .. | 3 | .. |
| Fell Off Work Train | .. | .. | 2 | .. | .. | .. | 2 | .. |
| Working on Cars or Engines | .. | 1 | .. | .. | .. | .. | .. | .. |
| Unclassified | .. | .. | 3 | 3 | 1 | 1 | 4 | 4 |
| Total | 3 | 12 | 26 | 12 | 22 | 7 | 51 | 31 |

In addition a number were killed by the electric roads:

| | Killed. | Injured. |
|---|---|---|
| Run Over | 5 | 1 |
| Falling Off Cars | .. | 3 |
| Alighting | .. | 8 |
| Struck by Cars | .. | 8 |
| Car Struck Conveyances | .. | 4 |
| Totals | 5 | 24 |

As to delays and damages to rolling stock the following notes are of interest:

Near Glacier, B.C., a train of empty coaches was derailed and ran over an embankment.

Considerable damage to rolling stock, wrecked by a defective rail on Halifax & South West Railway, near Yarmouth.

At Chatham, Ont., much rolling stock damaged and track torn up. Traffic block for hours. Cause, defective equipment.

Near Brandon, defective rail ditched engine and six freight cars.

Defective equipment completely wrecked the baggage car and tender off the engine, at Alton, near Orangeville.

Three trains were held up nine hours through a wash-out near Swift Current, Sask.

A broken flange on the wheel of a tender caused derail of the tender and bagagge car of a passenger train near Shelburne, Ont. Delay 5 hours.

At Lake Joseph, Ont., a train ran into an open switch and caused considerable delay to traffic.

At Innisfail, Alta., express derailed and much rolling stock damaged, four injured.

A defective wheel threw tender off rails at Langford, and caused much damage to engine and the roadbed.

At Bala, Ont., nine cars of a freight train were derailed. Probable cause, broken flange.

## OILED ROADWAYS.

The results of the experiments made at Hamilton, Ont., with oil on highways is contained in a report made by W. C. Brennan to City Engineer E. G. Barrow.

The oiling of roadways as a dust preventative was tried on three streets, viz.: Catharine street, between Rebecca and King streets; Herkimer street, between Locke and Queen streets, and Hess street, from Main to Duke streets. Catharine street, from Rebecca street to King street was first selected on account of being a heavily travelled street in good condition in the center of the City, and having no houses on it, and from which it would be expected complaints would be made as to tracking on the carpets, etc. The oil used was some which had been procured for fluxing asphalt. It was found, however, that the oil, while it laid the dust for some time, was not a "road builder," and after about one month it was necessary to put the watering carts on again.

| | |
|---|---|
| Cost 500 gallons oil at 9¼c | $46 25 |
| Screenings | 1 50 |
| Labor | 11 59 |
| Rolling | 4 00 |
| 1,600 yards | $63 34 |

Cost per yard, 4 cents.

For Herkimer and Hess streets a heavy oil with an asphalt base was procured from the Indian Refining Co., of Georgetown, Ky. This oil gave good results and a first-class job was produced, though the residents on these streets complained of the tracking of the oil by delivery men, etc.

Herkimer street and Hess street both have car lines laid on them, and it was found that, after watering, they soon dried up, and the quickly moving cars caused the dust to fly.

The expense item on both these streets was:

| | |
|---|---|
| Oil | $393 20 |
| Labor | 83 32 |
| Roller | 18 00 |
| Screenings | 12 00 |
| | $506 52 |

Herkimer st.....5,133 yds.
Hess st.....4,733 "

9,866 yds.—$506.52—.5c per yard.

The experience gained is that with a proper oil, properly applied (in this case at a temperature of about 140 to 170 degrees), and the roadway in good condition, it is much more satisfactory than street watering, and while the cost is more per square yard than for watering for a season, it should be borne in mind that the roadway is preserved and much improved, and the dust nuisance entirely abated. The use of heavy oil, such as was used on Herkimer and Hess streets is objectionable for the few days after application, but soon forms a good roadway, equal in many respects to asphalt, and is entirely dustless in dry weather, and undoubtedly lengthens the life of the roadway.

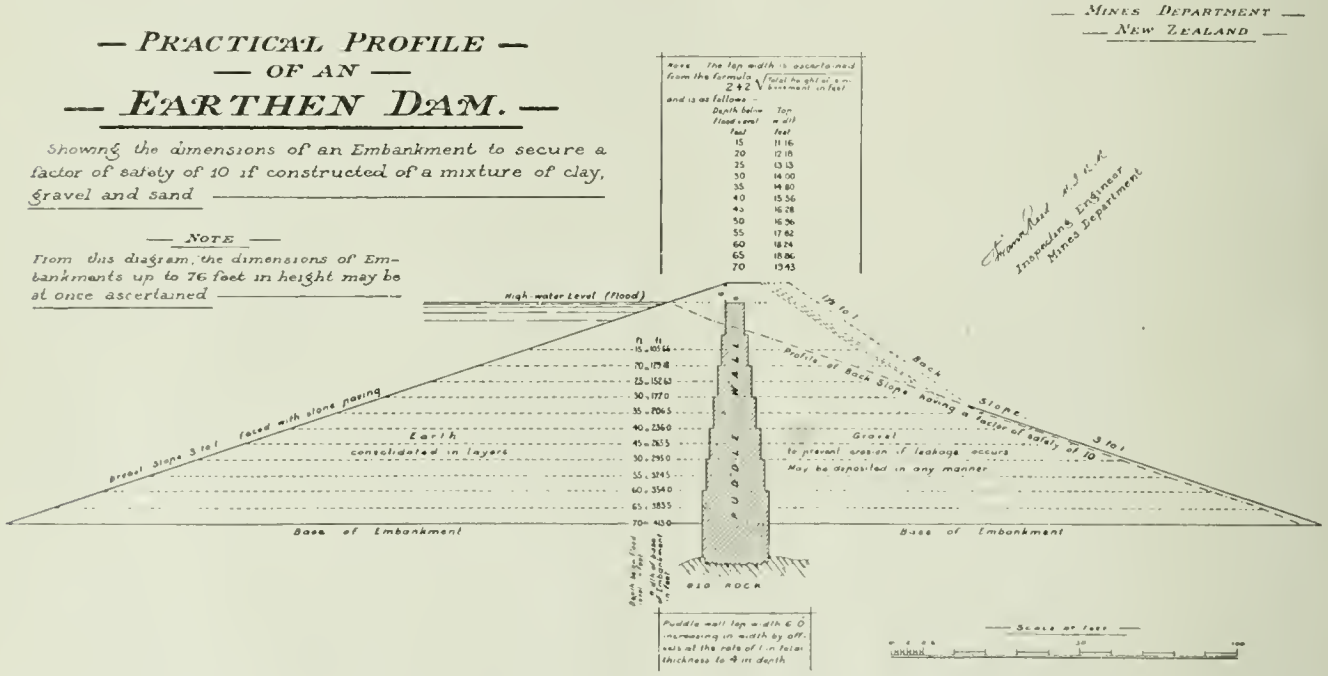
## EARTHEN DAMS.*

By Frank Reed M.I.M.M., Inspecting Engineer of Mines, New Zealand.

Of all earthworks, the design and construction of the earthen dams requires the greatest care, and it is remarkable that so little literature exists upon the subject. Brief reference is made to such dams in Molesworth, Spon and Trautwine, but with little unanimity, and the formulae given are of an empirical character. Gordon, in "Mining and Engineering," deals with the subject in a practical manner; and E. Wegmann, in "The Design and Construction of Dams," draws attention to errors in construction which should be avoided.

The writer has occasionally been called upon to design, carry out the construction of, or report upon earthen dams on the goldfields of New Zealand and West Australia, and has left the requirements of some recognized standard upon which to base his work. Regarding masonry dams, however, much has been written, notwithstanding that the earthen dam is more complicated both to design and construct.

For the purpose of assisting mining companies and others who propose to construct an earthen dam, the writer has prepared the following specification, accompanied by a


— PRACTICAL PROFILE —
— OF AN —
— EARTHEN DAM. —
Showing the dimensions of an Embankment to secure a factor of safety of 10 if constructed of a mixture of clay, gravel and sand
— NOTE —
From this diagram, the dimensions of Embankments up to 76 feet in height may be at once ascertained
— MINES DEPARTMENT —
— NEW ZEALAND —
High water Level (Flood)
Breast Slope 3 to 1
faced with stone paving
Earth consolidated in layers
Base of Embankment
Profile of Back Slope having a factor of safety of 10
Gravel to prevent erosion if leakage occurs May be deposited in any manner
3 to 1
Base of Embankment
Puddle wall top width 6 0 increasing in width by offsets at the rate of 1 in total thickness to 4 in depth
Scale of Feet

diagram, or practical profile, which is based upon actual practice. From the diagram may be ascertained at sight the profile and dimensions of any dam up to a height of 76 feet, which, if constructed according to the specifications will be capable of resisting ten times the hydraulic pressure in the reservoir; but it should be understood that the design of earthen dams must not be based entirely upon mathematical calculations of equilibrium and safe pressure, for much depends upon the materials used and the reliability of the workmanship. The width of the crest of the embankment will depend upon the amount of erosion that it is likely to be subject to. In countries where torrential rainstorms occur a greater width will be necessary than in dry countries. Therefore, no hard-and-fast rule can be devised, but it is well to have the width adequate, for dams when constructed in remote places are often left unattended, while the erosion goes on continuously. Trautwine's formula for width of crest—viz., 2 feet + 2 $\sqrt{}$ total height in feet, is but rule of thumb, although a safe one which may be modified according to the material used and locality of the dam. The height of the crest above high water level should be sufficiently raised to be beyond the reach of the highest waves.

Allowing the depth of water in the by-wash during extreme flood to be 2 feet 6 inches, and a high wind prevailing, the crest of the waves will reach about 5 feet 3 inches above the ordinary by-wash level in a reservoir a mile and a half long, and the crest of the embankment should, therefore, be 6 feet at least above high-flood level in long reservoirs.

The profile of the back slope of the embankment shown in the diagram has been determined on the assumption that material weighing from 104 lb. to 108 lb. per cubic foot is used,** and that this material has a coefficient of frictional resistance of 1.† A factor of safety of 10 has been given to the embankment (as adopted by Gordon).

The material used in the embankment on the downstream side of the puddle-wall should be as open as possible, to prevent erosion if leakage occurs. Gravel alone may be advantageously used in this part of the embankment, as it tends to fill up a hole which may be formed by erosion, whereas clay is apt to arch over an openinig, which may be enlarged, and lead to rupture of the structure. To deposit the material in this part of the embankment is consolidated layers, as on the front of the puddle-wall, is but waste of money for should the water find its way through the consolidated front and puddle-wall it would soon percolate through the back.

In the Boston Waterworks dam, referred to in Molesworth, the practice here recommended has been carried out.

Unless the dam is fenced off, it is a great mistake to sow grass upon the outer slope, for this attracts cattle and other stock, which destroy the batters and contaminate the water.

On no account should an earthen dam be constructed in a river gorge where high floods occur, for under such conditions the dimensions of an adequate by-wash would be so formidable as to be prohibitive both in construction and cost.

In the profile it will be noted that there is no berm, and unless the factor of safety of 10 be increased or diminished, or the width of the crest is reduced, there is no place for a berm, and with 3 to 1 slopes (the breast slope being paved) the writer is of the opinion that a berm in such a dam is superfluous.

Specification of earthen dam (to accompany profile showing dimensions of any dam not exceeding 76 feet in height.

Embankment.—The embankment shall rest on impervious stratum of clay or rock; all porous material, such as sand, gravel, and fissured rock, should be removed. The surface under the base of the embankment, on the upstream side of the puddle-wall shall be broken with spade or plough, in order to form a bond with the earth deposited.

The embankment on the upstream side of the puddle-wall shall be constructed of selected material, preferably a mixture of sand and clay divested of roots or other perishable

* In the New Zealand Mines Record.

matter; the percentage of clay shall be determined by the Inspector of Works, and shall depend upon the nature of the materials with which it is mixed.†† The embankment shall be carried up in uniform layers slightly hollowing towards the centre and not exceeding 1 foot in thickness. Horses and drays shall be used, and each layer shall be consolidated by wetting to incorporate it with the layer below. The upstream face of the embankment shall have a breast slope of 3 to 1. On no account shall material be sluiced into the embankment on the upstream side of the puddle-wall. On the down-

equal 2 feet + v' height of embankement in feet.

stream side of the puddle-wall the earthwork shall be of open, porous material, such as gravel, to prevent erosion if leakage occurs; such material may be deposited in the most convenient manner. The top width of the embankment shall

All slopes shall be commenced full out to the side-pegs, and be carried regularly up as the embankment progresses. When the embankment has been raised 3 feet the sides shall be trimmed with slope boards, and any irregularities appearing on the slope shall be corrected at once. This trimming shall regularly progress as the embankment increases in height. There shall be an allowance for subsidence of 1 inch for every foot in height of embankment.

Puddle-Wall.—The nucleus puddle-wall shall form a solid and impervious core to the embankment, and shall be sunk for a distance of 1 foot into the bed-rock or a thick solid impervious stratum.

The wall shall be formed of strong, tough clay of tenacious character, put through a pug-mill. Clean gravel, not exceeding in proportion one-third of the whole, may be mixed with the clay. The clay, in a thoroughly firm condition, shall be put into the trench in layers of about 1 foot in thickness, and each layer firmly punned, by means of a rammer weighing not less than 20 pounds, before another layer is put on.

The puddle-wall shall be carried up simultaneously with the embankment.

The top of the puddle-wall shall be at the same level as the by-wash flood-level, and have a top width of 6 feet to 8 feet, increasing downward by offsets at the rate of 1 in total thickness to 4 in depth.

Paving.—The inner slope of the embankment shall be paved with rectangular stones at least 15 in. § in thickness, resting on a layer of broken stone, clay,, and fine gravel with a covering of sand. The facing shall be carried down below the surface to a solid foundation.

Outlet Pipes.—All pipes passing through the embankment shall be laid in masonry or concrete for the whole length. No timber shall be used in any dam. Waste--pipes shall start from the lowest part of the reservoir.

By-wash.—The by-wash shall be cut out of the solid ground as far away from the embankment as practicable, and shall have such a width that there is no possibility of the water flowing over it to a greater depth than 2 feet to 2 feet 6 inches. The sides and bottom of the by-wash channel shall be paved with stones, and, where falls have to be constructed, they shall be of strong masonry set in cement, with the wells at the bottom of each fall to hold such a depth of water as will act as a cushion. A series of low falls are always preferable to a sudden drop from a great height.

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**This is probably less than it will actually weigh; a consolidated mixture of clay, sand and gravel may weigh about 126 pounds per cubic foot.

† This may be slightly excessive; it is given in Fanning's Treatise on Hydraulics.

††Clay alone or in a large proportion will not answer the required purpose, as it swells when wetted and shrinks in drying. No general rule can be laid down, but from 5 to 20 per cent. of clay in the consolidated layers forming the upstream side of the dam will often be found sufficient.

§ In important dams the paving-stones should be 24 in. thick.

## ASPHALT-MACADAM ROADWAYS.*

Clifford Richardson.

It is somewhat surprising to me who has been a close observer of the development of the modern sheet asphalt pavement in the United States, during the last 40 years, that so little application has been made of the experience gained in that industry to the problem of the construction of bituminous macadam roadways, which shall meet the conditions which exist to-day.

There should not be any essential difference in principle in the construction of a sheet asphalt pavement and a bituminous macadam roadway. Both consist of a mineral aggregate cemented together with a bituminous binding material, the aggregate in one case being fine, and in the other, containing coarse particles. Experience has shown that, in either type of surface, the mineral aggregate being of a suitable character, the capacity of the resulting surface to resist travel will depend on the more or less satisfactory nature of the cementing material.

In the early days attempts were made to construct pavements in Washington and elsewhere with both fine and coarse aggregates, using coal tar as a cementing material. All these attempts with both fine and coarse aggregates were failures to a greater or less extent and its use was abandoned on the advent of the form of asphaltic construction developed by DeSmedt, although it was revived for a few years in the late '80's in mixture with asphalt with equally disastrous results. The surfaces having a coarse aggregate were somewhat more lasting than those made with sand and a small portion remained in place until the end of the century. They were known as Evans pavements, and were resurfaced with asphalt after a few years. One of these, protected by an asphalt surface, was found, on repaving Connecticut avenue, in Washington, in 1906. A piece of it was collected by the writer and examined. From this it appears that a coal tar bituminous macadam was constructed as long ago as 1873 and proved, in a short period of time, not to be a lasting form of construction. Notwithstanding this fact, experiment after experiment has been conducted along the same lines in recent years with similar results. Few, if any, highway engineers seem to have benefited by the experience of their predecessors, and most of them still have the coal tar lesson to learn on their own part, although it is evident that this form of construction cannot give satisfactory results for more than a few years.

On the other hand, referring again to the lessons of the paving industry, the modern sheet asphalt pavement, where constructed on rational lines on a rigid, well drained foundation, has proved a complete success, as exemplified by the fact that a pavement of this type has satisfactorily resisted the heavy travel which is found on Fifth avenue, in New York City, 14,000 vehicles in the period between 6 a.m. and 7 p.m., for a period of twelve years. In the same way, an asphalt concrete surface constructed with a well graded, but coarse mineral aggregate in 1902 in Muskegon, Mich., which has been used as a favorite drive since that time, has been in use with no repairs whatever where many similar surfaces in which coal tar has been the cementing material have deteriorated or required resurfacing under similar circumstances during the same period. The Muskegon work has not only demonstrated the superiority of asphalt as a cementing material, but this has been confirmed by other surfaces of the same form of construction in Owosso, Mich., in Paterson, N.J., Scranton, Pa., Staten Island, N.Y., and elsewhere.

The evident conclusion which may be drawn from past and present experience is that success can be arrived at in the construction of any form of bituminous road surface only by the use of asphalt as a cementing material. The thing to be considered, however, is how can asphalt be used in building the cheaper forms of country highways which are now in demand, to resist motor and concentrated traffic,

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*Presented at the Road Congress in Seattle, Wash.,

where the aggregate is merely of the grading of the ordinary stone which is employed in surfacing macadam roads? The asphalt surface construction in Muskegon in 1902, and elsewhere, was an asphaltic concrete. The mineral aggregate was well graded and, in itself, compact. This could only be combined with the cementing material in a hot condition, which required a plant to which the aggregate was hauled and from which it was again hauled to the point where it was put in place. The operation was, therefor, an expensive one, and makes the cost of this form of construction prohibitive for country roads. Recourse must, therefor, be had to some other method of combining a mineral aggregate and asphalt immediately on the spot where the surface is to be constructed.

For many years tar macadam has been laid in England, France, and, to a smaller extent, in this country in Rhode Island, New Jersey and elsewhere. This form of roadway is arrived at by coating the No. 2 or surface, stone of the macadam with coal tar in one way or another, either before or after rolling it, and afterward filling the voids in the surface with more tar and grit, screenings or sand. Such a surface is desirable when first fininshed, but it soon begins to deteriorate, and ravel, especially when exposed to horsedrawn travel, with the weathering and ageing of the cementing material. From past experience, it is not difficult to arrive at the conclusion that if an asphalt cement were substituted for the coal tar a result would be attained which would correspond to the improvement which was evident on the substitution of asphalt for tar in street pavements.

The difficulty lies in the fact that an asphalt cement is much more viscous than tar. It must be used in a much better condition and does not mix with or adhere so readily to cold stone. Experiments have shown, however, that this can be accomplished by using a much softer asphalt than is customary in street asphalt pavements, or even in surfaces of the type of the Muskegon pavement. To-day, we find ourselves, after some experiment, in the position of being able to coat stone, of the type used in macadam surfaces, with an asphalt cement which serves satisfactorily as a binder for such an aggregate, on a metal mixing board with hand labor and shovels at the point on the road where the material is to be put in place and with very reasonable economy. It produces a surface which, while not of the stability or having the wearing properties of the Muskegon type, is as far superior to the ordinary tar macadam as the sheet asphalt pavement is superior to one of the tar poultices of 35 years ago.

The base of the cementing material must, however, be an asphalt of the best quality, such as is used in the construction of sheet asphalt pavements; in fact, it must be an asphalt paving cement such as is called for under the strictest municipal specifications, but merely made softer by the use of a larger percentage of flux. Dense oils and residums to which no solid native bitumen has been added will not accomplish the same results to any greater or more satisfactory degree than they would if used in a street pavement. Further, the character of the flux in asphalt cements for use in macadam must be more carefully taken into consideration than that for use in street pavments, as the amount is so much larger, in consequence of which it has a greater bearing on the character of the cement.

On the Pacific Slope the opportunity for the construction of roadway of the highest type, which has been described, is facilitated by the fact that vast quantities of residual pitch and flux, most of it of suitable quality, is available as a cementing material or binder, so that all that is necessary is a certain amount of skill and experience in handling it to attain the best results. In fact, there is no part of the world which is so favorably situated for solving the road problem as the State of Washington, where stone of the highest grade is available for the mineral aggregate, and a cheap and abundant supply of cementing material from the neighboring State California. The State is to be congratulated on the opportunities which it has in these directions, upon the energy with which the road problem is being attacked, and upon the prospects of success which lie before it.

## A COMBINATION OF GAS-PRODUCER AND COOKING CHAMBER.*

**Otto K. Zwingenberger, New York.**

The technical use of peat is, in some ways, in an unsettled state, but the fact clearly stands out that besides its use as a filler for fertilizer, packing material and the like, excellent chances are offered by the gasification of peat in the gas producer. If there are any questions on the gas producer for peat which are still to be settled, these are:

1. The question whether to run gas producers with the recovery of by-products and especially of ammonia as ammonium, sulphate, or,

2. Whether it is to be preferred to blow up all the tarry by-products, without any care what becomes of the nitrogen.

As to gas-producers with the recovery of by-products, there is no doubt about it that this system will only pay when it is carried out on a larger scale, and the initial cost for the apparatus is so high that it will nearly double the price of the gas-producer itself.

The condensation- of the tarry matter requires a condenser of sufficient length to remove all the tarry particles suspended in the gas. Now the condensation of such fine particles is not so easy, and the task of erecting an efficient condenser is a good job. One will soon find out that the condenser will not do its work if the diameter of the pipes exceeds a certain size, as the tar will not be solidified and one has to take pipes smaller in diameter to give the gas sufficient surface to be cooled by air, otherwise the gas will carry the fine particles into the cylinder and soon serious troubles arise by plugging the cylinder and by pre-ignitions. The price of such an efficient condenser is a considerable item and the work necessary to run the system in all its details for separating the ammonium, sulphate and the tar is very considerable.

In regard to the recovery of the ammonia from the gas, a part of the ammonia is dissolved in the tar-water coming down in the condenser; its separation from this weak solution cost steam and quicklime. The greater part of the ammonia is still in the gas and can be separated only by a complicated apparatus consisting of at least two-thirds towers with coke inside, over which sulphuric acid is flowing from the top. The absorption of the ammonia by the sulphuric acid is not such a plain matter in its technical part as it may look at the first glance, for the sulphuric acid must have a certain strength if it is to absorb ammonia in an effective way. Even if one takes the precaution to conduct the sulphuric acid through the towers in such a way that the gas in entering the first tower of the system meets the sulphuric acid, which in passing the whole system has absorbed a great quantity of ammonia and is now so weak that it is nearly saturated; notwithstanding this precaution one has always to handle an acid ammonium sulphate solution.

The pumping of the sulphuric acid from one tower to the other is not a pleasant business, and the whole running of such an ammonia plant needs so much attention and care that it can only be carried out in power plants of several thousand horse-power. The money value of the tar by-products is very little, and cannot be much considered, as they are not sufficient to enable the suport of a special by-product plant.

The Mond process for bituminous coal is up to now nearly the only representative of such a process and is only carried out in some few plants. In the United States there is just one Mond gas plant and that is here in Syracuse. The new modification for peat by Frank & Caro will certainly meet the same fate.

I have always maintained, for instance at the meeting of the New York Section, that by far in the greater number of cases the conditions for power plants run on peat will not admit of an erection of a by-product plant, even in cases when the size of a plant is to come up to 1,000 horsepower,

*Read at the Syracuse Meeting of the American Peat Society.

for in peat propositions we have also to figure on the location, freight, etc., and location, and its consequences, give also in these points only too often peculiar aspects.

Whatever the location of a power plant may be, there will always be a demand for power itself and for both air-dried peat and peat coke, or, if necesary, this can be created.

The profit many people are expecting from the sale of the ammonium sulphats make them overlook one fact in regard to the Frank-Caro process, namely, that a considerable amount of gas produced, more than one-third of it is consumed in superheating the steam for decomposing the nitrogen preparations in the peat to ammonia. It is an old law, as old as the world, that one can't buy anything for nothing, and one has always to pay for an advantage on the one side by a sacrifice on the other. It goes without saying that the use of a great deal of the produced gas for superheating the steam is an item worthy of the greatest consideration, and I would not be surprised if many advocates of the saving of the nitrogen in the form of ammonia have not gone too far into the realization of this fact. It is due to this fact that for power plants of medium size, one does better not to attempt ammonia recovery, but in big plants the conditions in regard to expenses for the several parts of the work are subject to quite a different consideration in comparison to plants of smaller units. For if it comes to the point the output of energy contained in peat, is in the Frank-Caro process, hardly more than 50 per cent., whereas in the Ziegler process, where the coke stands in the front and the by-products in the second line, the output of energy in peat amounts in the average up to 75-80 per cent.

The gas obtained in the Ziegler coking process, is relatively very rich. It carries about 330-350 B. t. u. and is an excellent gas for running gas engines on account of its high content of hydro-carbons. It does not run so high as the gas obtained in the distillation of bituminous coal, as, of course, by the destruction of organic matter in peat, the generation of carbonic acid gas cannot be prevented. The conditions favorable for the existence of a Ziegler plant are given only by peat-bogs of considerable size, whereas gas-producers can already live on smaller peat-bogs. Now there arises the question: Could we produce from peat a gas richer than the average gas from producers and coming near to that produced by Ziegler in his coking process?

This question can certainly be answered in the affirmative, if we combine the gas-producer and coking chamber together in one producer, as is done by my gas-producer, protected by United States patent letter. From peat we can nowadays produce a gas as rich as that from anthracite or coke, and if we take advantage of the hydro-carbons in the volatile matter of the peat, we can manufacture a gas not quite as strong as that of the Ziegler process but which is hardly below 300 B. t. u. as, furthermore, all the tar is transformed into permanent gas. The tar, being nothing but liquid hydro-carbons, transformed into gas, and the hydro-carbons of the volatile matter, represent the best gas we may wish for power purposes. The output of energy of such a gas-producer is equal to that of a Ziegler coke oven, for we are able to draw from one chamber, besides the gas obtained, 25-30 per cent. of peat-coke, figured on air-dried peat of 25 per cent. water. The resulting coke is not quite as hard as that of the Ziegler process, but it is hard enough to stand transportation and handling.

The principle of my gas-producer consists in the combination of a regular gas-producer with a coking chamber; the latter admits also of the possibility to be run as a gas-producer, in which the process is going on in the same way as in a regular gas-producer run on coke; on the other side it allows easily drawing off the coke if the production of coke is intended.

The producer consists of a regular chamber divided by an upright partition which terminates at some distance below the top. This partition may be diminished at the middle portion and is provided in its upper portion with transverse channels. If a fire is started over the step-grate in the proper chamber, this side is run as a peat gas-producer; all the gases, tarry substances and steam (the latter resulting from the water of the peat on top), pass over the partitions and the channels in the same into the other chamber opposite the partition, where the peat is carbonized by the heat of the gases as well as by the heat radiating from the producer chamber to the other. The gases, tarry matters and the steam pass through the high column of glowing fuel, so that the tarry matters are decomposed and transformed into permanent gas, while the steam acts on the glowing carbon and is decomposed to carbon monoxide and hydrogen. If at the bottom of the second chamber a fire grate is applied, one can run this chamber, too, as a gas-producer, with an outlet for the gas on the side. If the second chamber is to produce only coke, one takes out the coke at the bottom and draws off the gases at the side. Great advantages will be obtained by erecting a series of gas-producers in one continuous line, as the effects of two producer chambers—"A" on one coking chamber, "B" will be more efficient by radiation of the heat; the outlet for the gas in such a case would have to be taken to the front side.

This gas-producer yields a richer gas than any other gas-producer, produces a satisfactory quality of coke in good quantity, and its cost of erection would be even somewhat smaller than that of the average gas-producer, owing to the simple construction.

It has to be stated here, that this gas-producer does not save the nitrogen and its construction was also not intended for that purpose. What it was constructed for and where its main force lies, is in its great adaptability for both peat and lignite, or even bituminous coal, that it may easily be run in small units of 100-200 horsepower, which may be conveniently united to large systems as the conditions may require.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7640—July 27—Authorizing the C.P.R. to use and operate the following bridges: 1, Broken Head River, Molson Cut-off, Kenora Section; 2, Drainage Ditch, Molson Cut-off, Kenora Section; 3, Cook's Creek, mileage 15.86, north-east quarter, Sections 30-11-6, east Principal Meridian, Cook's Creek, East Branch, mileage 16.52, south-west quarter, Sections 32-11-6, East Principal Meridian.

7641—July 26—Authorizing the City of Guelph to lay a sewer pipe under tracks of the G.T.R. and C.P.R., at Marcon Street, Guelph, Ont.

7642—July 26—Authorizing the City of Guelph, Ont., to lay a sewer under tracks of G.T.R., on Norwich Street, Guelph.

7643—July 22—Authorizing the Citizens Telephone Company to erect wires across tracks of C.P.R. south of Cowansville Station, Quebec.

7644—July 26—Authorizing the Bell Telephone Company to carry wires across tracks of Toronto Hamilton & Buffalo Railway at public crossing 2½ miles west of Stony Creek Station, Ont.

BRACEBRIDGE.—The by-law to raise $45,000 for the construction of a hydro-electric plant of 1,000 horse-power capacity at Wilson's Falls on the Muskoka River, carried by a large majority on Monday last. Construction will proceed immediately so that power may be delivered before December 1st. Tenders will be called for very shortly by C. H. & P. H. Mitchell, Engineers, Toronto.

CHAPLEAU.—The Chapleau Electric Light and Power Company are constructing a new hydro-electric plant on the Kebsquashing River, about half a mile from their present plant. The market consists of lighting and motors. Contracts have been made with William Kennedy, Owen Sound, and the Allis, Chalmers, Bullock Company, for turbine and generators. Messrs. C. H. & P. H. Mitchell, Consulting Engineers, of Toronto, are engineers for the company.

# ENGINEER'S LIBRARY

## BUILDING UP A LIBRARY.

It is all very well to wish to be a student but how can you be a student without a library of your own? A library is an investment not an expense and one of the best investments a young engineer can make. But just as there are various kinds of safe investmets in the monetary world so there are in the world of books.

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## BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

**Report on the Iron Ore Deposits of Nova Scotia,** by J. E. Woodman, Department of Mines, Ottawa (Gov. Pub.). Pages, 222. Sixty-three illustrations. Size, 6 × 9.

The mines branch of the Department of Mines, Ottawa, which was organized for the purpose of devoting special attention to the economic features of Canada's mineral resources has just issued a comprehensive report on the Iron Deposits of Nova Scotia, prepared by Dr. J. E. Woodman, until recently Professor of Geology at Dalhousie University, Halifax. This report covers very thoroughly the more important iron deposits of the province. Special attention is given to:

1. Localities of iron ore deposits so far discovered, and names and addresses of owners.
2. History of development of mines and companies (if any).
3. Geological description.
4. Analyses of ores.
5. In cases of mines which have been worked, output and statistics.
6. Transportation facilities.
7. Limestone in neighborhood of deposits.
8. State in general terms character of forest in neighborhood, i.e., whether the supply is sufficient for mining purposes and for the production of charcoal in the event of the introduction of electric smelting.
9. Maps of mines (and drill holes, if any).

The Report itself is divided into two main parts:

Part I. deals with the geographic relations of the deposits, their mineralogy and geology, and questions relating to mining policy, bounties and mining laws.

Part II. is entitled "Details of Iron Districts," and covers more particularly the ores of the Clementsport basin, the Nictaux-Torbrook field, the deposits of Hants and Colchester Counties, the ores of the Western Cobequid Mountains and of Arisaig, and the ores of Cape Breton, and is replete with analyses of ores, records of bore holes and geological sections, and other statistical data.

A second volume covering iron ore deposits not referred to in Vol. I., and devoting special attention to limestones of value for metallurgical purposes will shortly be issued.

Copies may be obtained on application to Dr. Haanel, Director of Mines, Ottawa.

**Earning Power of Railroads.** Edited by Floyd. W. Mundy. Published by James H. Oliphant & Company, 20 Broad Street, New York. Size, 5 × 7. Pages, 430.

This book gives statistics for practically all the railroads in the United States, Canada and Mexico. The first ten chapters explain in a general way the fundamental principles to be applied by the investor in satisfying himself as to the value of the stocks and bonds of any railroad. These are followed by tables giving earning power, mileage, capitalization, etc., and permit of easy comparisons between roads. It is a work of value not only to investors, brokers and shareholders, but engineers and railway superintendents will find it a convenient book for reference.

**"Red Book"** (American Street Railway Investments), published by the McGraw Publishing Company, 239 West 39th Street, New York. Size, 10 × 13. Pages, 500. Price, $5.

American Street Railway Investments, the Electric Railway Journal's annual "Red Book," is a reference manual of electric railway statistics and finance. It is a publication devoted exclusively to street and interurban railway properties, and is more complete and reliable than manual's usually are. There are over 450 pages devoted to reports of more than 1,500 operating and controlled companies in the United States and Canada. The complete reports furnish information on the following subjects:—Charter, Franchises, etc.; Leased Roads; Capital Stock and Dividends; Funded Debt, including dates of issue and maturity, interest paid, trustees of mortgage, etc.; Operating Receipts and Expenses, Fixed Charges, Taxes, Surplus, etc. (four or five years comparisons); Balance Sheet; Plant and Equipment; Officers and Directors (names and addresses); Names of cities and towns connected by each road; Maps of important Systems. The date of information is stated definitely at the end of each report.

The 1909 edition is more complete than usual.

**Tacheometrical Surveying,** by C. Xydis, C.E., of the E.P.C. of Paris. Published by E. & F. N. Spon, Ltd., 57 Haymarket, London, Eng., and Spon & Chamberlin, 123 Liberty Street, New York. Pages, 100. Size, 6 × 9. Price, $1.75.

This handbook presents the results of the author's twelve years' personal experience of Tacheometrical (Stadia) Surveying. This system of surveying is now generally employed for preliminary plans and such plans usually show a high degree of correctness. The author describes how with a good transit having stadia attachments readings for distance, location and elevation may be taken. The handbook is supplied with tables for the reduction of these readings. Sample field notes are given and diagrams explaining the methods. Altogether it gives in concise and convenient form the information desired by those anxious to reduce field work to a minimum.

**The Reinforced Concrete Pocket Book,** containing useful tables, rules and illustrations for the convenient design, rational construction and ready computation of cost of reinforced concrete girders, slabs, footings, columns, etc. By L. J. Mensch, M. Am. Soc. C.E. Price, $10. The Canadion Engineer Press, 62 Church Street, Toronto, Ont.

During the last six years close to 100 text and handbooks were published on the subject of reinforced concrete, and amongst all these the reinforced concrete pocketbook is certainly the most original book. It represents the experience of a well-trained engineer and of a successful contractor, and information which is ordinarily kept a trade secret is unreservedly given to the public. The book is entirely free from the mathematical deductions which so often annoy and confuse the student and practitioner and

which often are nothing else than an attempt to explain some particular text by a pet theory.

The information given in this book is based on actual tests only, and represents the best average of tests to be found anywhere, and the author succeeded to explain his tables by a few, easily grasped, rules. The style of the book resembles those of the standard steel pocket books as Carnegie, etc., the tables are neatly printed and simply presented.

The first two tables give the areas and weights of one and of all combinations of four, six, and eight bars, both for rounds and squares.

The next six tables give the properties of Tee beams for stem dimensions of 3½ × 6¾ inches to 17 × 54 inches, and for safe bending moments of 4,000 to 2,000,000 feet lbs. The tables give the allowable shear, the weight of the round or square reinforcements including stirrups and overlaps foot of slabs, for various spacings of these rods is given in and the contents of the concrete sections per lineal ft.

The sectional areas of round and square bars per lineal foot of slabs, for various spasings of these rods is given in the next four tables. Also the weight of these bars for the various spacings in simple and square slabs per square foot.

The next 11 tables give the safe bending moments and the sectional areas of the reinforcement of slabs, for thicknesses of 2 to 600 inches and percentages of reinforcement from ¼ to 1¼ per cent. Also the bending moments in simple and square slabs for spans up to 25 feet and floor loads up to 1,000 pounds.

The sections and the reinforcements per lineal foot of wall footings is given in the next two tables for pressures on the ground up to 10,000 pounds per square ft. and for projections up to 7 ft.

The design of column footings for pressures up to 10,000 pounds per square foot and from 4 to 20 feet square is clearly given in the next four tables, also the quantities of concrete and steel in each footing for ready estimating.

The next eight tables gives the properties of all practical sizes of columns, reinforced by 4, 6, and 8 round and square bars and for hooped columns. The column loads are given in 1,000 pounds; the weight of the reinforcement, the cubical contents of the concrete and the required form lumber per lineal foot are given for each case, so that estimates of cost can be readily made. Even the gas pipe sleeves, to connect the superimposed columns, and their weights are not forgotten. The sizes of all girders, beams and columns are based on the commercial size of lumber, which are generally considerably below the nominal size, and makes the sizes of these girders and columns appear at the first sight odd, but the adoption of which will greatly diminish the cost of the form work.

The next 11 tables give the complete design of the mostly used floor construction for columns spacings from 12 × 12 feet to 20 × 50 feet and for floor loads up to 500 lbs. per square foot. The most economical layout of girders and beams is indicated for every case, the sizes and reinforcement of girders, beams and floor slabs are clearly specified, and for the purpose of estimating the average quantities of concrete, steel and the required form lumber is given per square foot, which enables the reader at a glance to compare the cost of various spans and various floor loads.

The next two tables give the design and quantities for girderless floor constructions for column spacings of 12 × 12 feet to 25 × 25 feet and floor loads up to 500 lbs. per square foot. A rational method of designing such floor is given.

The next 33 pages contain an explanation of the foregoing tables, including many examples how to use them, also a table for the design of stirrups in girders. In the explanation of footing design are presented new designs of cantilever footings for both columns and walls, which are cheaper and simpler than those ordinarily adopted.

A detailed design and computation of cost of a five-storey reinforced concrete building, with different floor loads on each floor is next presented. Methods and arrangement of tables to reduce the labor of such computations to the minimum are shown, and although these tables contain every detail both in design and for the computation of cost, they do not occupy more than four pages of the book.

This chapter closes the portion of the book devoted to building work. The second portion is devoted to engineering structures, and the various tables not only give the complete design of the structures, but also the unit quantities or total quantities, as the case may be, of concrete, steel and form lumber, so that the cost of each structure can be found at a glance.

The design of retaining walls of the cantilever and of the counterfort type up to 50 feet high is given in two tables, and is followed by explanations and figures.

Tanks are treated next, and a simple rule is evolved for finding the most economical sizes of tanks, while the tables on round tanks give the reinforcement and thickness of shells up to 2,000,000 gallons capacity, the design of the bottom and of the spherical cover, for spans up to 50 feet and for loads up to 2,400 pounds per square foot. The design of rectangular tanks is next presented and compared with the cost of round tanks. Two pages are devoted to the design and the quantities of elevated water tanks for capacities up to 1,5000,000 gallons and for various elevations above the ground.

Tables of round and square bins for grain elevators, coal bins, etc., are given in the next two pages, with complete data for the design of suspended bottoms.

Solid gravity and arched dams are next discussed and the design of arched dams, as proposed by the author, will be of special interest to hydraulic engineers. Novel types of reinforced concrete dams are fully designed in two tables for heights up to 250 feet.

The next nine pages give tables of water pipes up to 132 inches in diameter and for pressures up to 45 pounds per square inch, and a rational design of circular sewers up to 15 feet in diameter.

A complete design of piles from 20 to 100 feet in length is given on the next two pages, together with rules for driving and for the carrying capacity of such piles.

The chapter on arched bridges gives more positive information in regard to the design of such bridges than can be found anywhere. Based on the principle of catenary lines the author gives formulae for the most favorable line of an arch both for bridges with earth fill and for open spandril construction. He also gives formulae for the statistically indeterminate values of the thrust, reaction and moment at the left abutment for the case of concentrated load being applied at any point of a parabolic arch. From these formulae he finds and gives diagrams of the influence lines for the bending moments at any point of the arch. From these diagrams he deduces the most unfavorable loadings both for a moving uniform load and for concentrated loads.

The properties of arch rings of the solid type, of the rib and slab type and of ribs alone are given and referred to in the following tables which contain the complete design of arches from 30 to 500 feet span and for rises from 1/10 to⅓ of the span. A simple formula is given to find the temperature stresses in such arches, also a formula for finding the stresses, due to the shortening of the arch. In separate tables are given the stresses from the thrust, bending moment and from a change of temperature of 50 deg. F. for all the arches in the previous tables.

The use of these tables is explained by several examples, and data for the design of the abutment and for the quantities of form lumber are also included. The arches are all designed for a uniform load of 100 pounds per square feet, and for a 12-ton and a 24-ton wagon, according to Cooper's specifications.

Reinforced girder bridges are tabulated for spans from 15 to 60 feet and are figured for a 20-ton steam roller and a 12-ton and a 24-ton wagon.

A short discussion of framed structures, such as culverts and bridges which are monilithically connected with their abutments, and of arched ribs for shed follows in the next six pages, with a fully explained example of an elegant design for a shed of 85 feet span.

The next 11 pages give complete data for the design of about 80 chimneys varying in diameter from 5 to 20 feet and in height from 80 to 350 feet. The thickness of the various shells, their reinforcement, the size, depth and reinforcement of the footings and the total quantities of concrete and steel can be readily taken from these tables.

A table for the design of trolley and transmission poles, together with a simple formula for the deflection of such poles closes the chapter on engineering structures.

Some important notes on the cost of reinforced concrete work and some general specifications for the execution of such work form the last chapter.

## PUBLICATIONS RECEIVED.

**Annual Report of City Engineer for 1908, City of Fredericton, N.B.**—50 pp., 6 x 9. A. K. Grimmer, B.A.I., City Engineer.

**The Canada Year Book, 1908.**—Second series; 546 pp., 6 x 9, pub. doc. Archibald Blue, Chief Officer, Census and Statistics Office, Ottawa, Ont.

**Report of the City Engineer and Surveyor,** 1908-9, Birmingham, England. 56 pp., 6 x 9. Henry E. Stilgol, M. Inst. C.E., City Engineer.

**Tacheometrical Surveying.**—By C. Nydes. Published by Spon & Chamberlain, 123 Liberty Street, New York. Pp. 100; size, 6 x 9. Price, $1.75.

**Railroad Promotion and Capitalization.**—By Cleveland & Powell. Published by Longmans, Green & Co., 3 Fifth Avenue, N.Y. Size, 5 x 8; pp. 360.

**Electric Railway Power Stations.**—By Colvin F. Swingle, M.E. Published by Fred J. Drake & Co., Chicago. Cloth; pp. 800. Price, $2.

**Practical Armature and Magnet Winding.**—By Henry C. Horstmann and Victor H. Tousley. Published by Frederick J. Drake & Co., Chicago. Pocket size pp.250. Price $1.50.

**City Refuse and Its Disposal.**—By H. DeB. Parsons, lecturer on Steam Engineering, consulting engineer, 22 William Street, New York; 18 pages.

**Forty-second Annual Report** of the Commissioners of Waterworks of the City of Erie, Pa., for the year ended December 31st, 1908. George C. Gensheimer, Secretary-treasurer.

**Tests of Macadam Rock.**—By E. H. Beckstrand, Professor of Mechanical Engineering and Applied Mechanics. 15 pp., 6 x 9. Bulletin No. 2; State School of Mines, Salt Lake City, Utah.

**Tenth Annual Report** of the Board of Commissioners of the Water and Light Department of the City of Duluth, Minn., for 1908. 43 pp., 6 x 9. L. N. Case, Manager and Secretary Commission.

**Designing and Detailing of Simple Steel Structures.**—By Clyde F. Morris, C.E., Professor of Structural Engineering, Ohio State University. 200 pp., 6 x 9. Published by Ohio State University Columbus, Ohio.

**Relative Merits of Railroad Stocks and Bonds** and **Railroad Bonds as an Investment.**—By Floyd W. Mundy. 45 pp., 6 x 9. Compliments of Jas. H. Oliphant & Co., members of New York Stock Exchange, New York City.

**Gas Engine Theory and Design.**—By A. C. Mehrtens, M.E., Instructor in Mechanical Engineering, Michigan Agricultural College. 250 pp., 6 x 9. John Wiley & Sons, New York; Renouf Publishing Co., 61 Union Avenue, Montreal.

**The "Red Book" for 1909.**—Published by McGraw Publishing Co., New York. Size, 10 x 13; pp. 500. Price, $5.

**Waterproofing.**—By Myron H. Lewis, C.E., Published by the Engineering News, 220 Broadway, N.Y. Size, 6 x 9; pp. 50.

**Azimuth.**—By George L. Hosmer, Assistant Professor of Civil Engineering, Massachusetts Institute of Technology. Morocco leather binding, gilt edges, 75 pp., $1. John Wiley & Sons, New York. Renouf Publishing Co., 61 Union Avenue, Montreal.

**Five Thousand Facts About Canada.**—Compiled by Frank Yeigh, Toronto. Published by the Canadian Facts Publishing Co., 667 Spadina Avenue, Toronto. 1909 edition; 75 pp., 5 x 7; 25 cents. In concise form, five thousand interesting facts about Canada are given in the second edition of Mr. Yeigh's publication, which has been carefully revised and brought up to date. Most of the statistics relate to the year ended March 30th, 1908, the latest date for which figures are obtainable. Arranged alphabetically under subjects, the data are easily accessible, and everything everybody wants to know about Canada is presented in a terse and attractive manner by one who knows.

## CATALOGUES.

**Shafting.**—The Hill Clutch Company, of Cleveland, Ohio, are distributing to enquirers a booklet on line shaft bearings and Hill collar oiling bearings.

**Chain Adjuster.**—The universal patent chain adjuster and its uses are illustrated in a leaflet published by the manufacturers: Weldless Chain, Ltd., Gartsherrie, Coatbridge, Scotland. This adjuster may be used for shortening, pining, or adjusting the length of chains. A price list is given.

**Buckets and Dipping Machinery.**—Four types of Orange Peel and six types of Clam Shell buckets are illustrated and described in an interesting style by The Hayward Company, 50 Church Street, New York, manufacturers of excavating machinery of all kinds, in a booklet just to hand. Photographs, prices and full information will be forwarded on application to anyone interested, together with a copy of a booklet which shows the application of buckets to machines of many types.

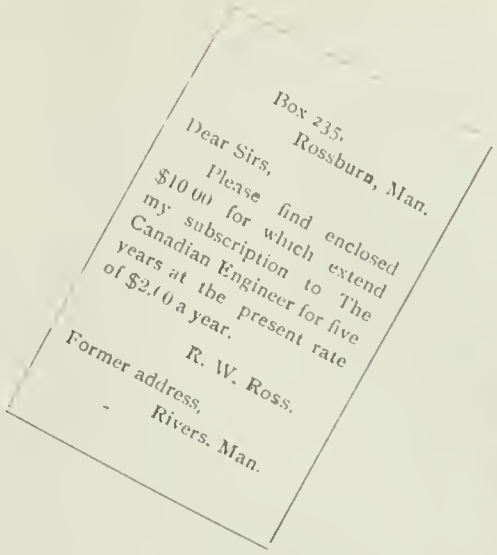
**Furnaces** for any fuel, either gaseous, liquid or solid, are manufactured by the Rockwell Furnace Company, 26 Cortland Street, New York City, and described by them in an elaborate booklet just to hand. The volume is replete with beautiful illustrations.

**Pneumatic Appliances.**—Pneumatic tools and appliances of all kinds, for all purposes, are profusely illustrated and described in a booklet just issued by the Howard Pneumatic Engineering Company, Ltd., of London, England. Interesting sections are devoted to grinders, drills, hoists, pumps, etc., manufactured by this well-known firm. They are contractor to the Admiralty, and are represented in Canada by John L. Richardson & Company, 65 Front Street East, Toronto, who will be pleased to forward a complimentary copy of their interesting publication upon application.

**Log Duplex Slide Rules.**—Keuffel & Esser & Company, New York, are distributing an eight-page booklet describing the rule and its method of use.

**Motors.**—The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has issued a handsomely printed little booklet describing the applications of its line of small motors to office, store and shop services. The numerous illustrations scattered through the pages suggest many time and labor saving uses for these efficient little power devices.

**Articulated Compound Locomotives.**—The American Locomotive Company has recently issued pamphlet No. 10,034, which consists of a very complete and instructive paper on the Articulated Compound type of Locomotive, read by Mr. C. J. Mellin, consulting engineer of the company, before the American Society of Mechanical Engineers. The paper very fully describes the characteristic features of this type of engine and the text is well illustrated by line cut drawings of its special details, as constructed by the above mentioned company. Line cut illustrations of the side elevations of a number of different designs of Articulated Compound Engines are also included in the pamphlet, among which are two preliminary designs for passenger service. The last ten pages of the pamphlet contain extracts from the discussion of the paper and half tone illustrations of a number of engines of this type built in the United States, the principal specifications of each design being given in tabular form beneath the illustration.


Box 235,
Rossburn, Man.
Dear Sirs,
Please find enclosed $10.00 for which extend my subscription to The Canadian Engineer for five years at the present rate of $2.00 a year.
R. W. Ross.
Former address,
Rivers, Man.

# A Generous Response

Already a large number of our old subscribers and some new ones have taken advantage of the offer made to receive new and renewal subscriptions up to August 1st at the old rate of $2.00.

Our Circulation Department report that during the past two or three weeks particularly, the number of renewals for from two to five years has been growing steadily.

Thinking that probably some may have overlooked it we have decided to hold the offer open for another two weeks.

If you want to be sure of the paper for the next few years at the $2.00 rate, please send us by the 15th of August the attached form with your check for any number of years at the old rate.

# Extension Subscription Form

Please find enclosed $.....for which extend my subscription for.....years at the present rate of $2.00 a year.

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**This Application should reach us by August 15th, 1909.**

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**League of American Municipalities.**—August 25, 26, 27, Annual Convention at Montreal; I. T. Jones, Des Moines, Iowa.

**League of American Municipalities.**—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

BUCKINGHAM.—Tenders will be received by the undersigned secretary-treasurer up to Monday the 23rd day of August, 1909, for the laying of a sewer pipe on Church Street, of the town of Buckingham. Plans and specifications may be seen at the office of R. W. Farley, C.E., at 362 Rideau Street, Ottawa, or at the office of the said corporation of the town of Buckingham. F. M. Gorman, secretary-treasurer.

MONTREAL.—Tenders will be received up to Wednesday the 18th August for the supplying and installing of a complete heating plant in the Corporation shops on Grand Trunk Street; prices are asked for a "Complete Steam Heating System," and also for a "Complete Hot Air Heating System." All information required may be obtained from the superintendent at the Corporation Yard, No. 700 Grand Trunk Street. L. O. David, city clerk.

ST. CHARLES.—Tender for sewer will be received at the office of the undersigned, or at the office of C. C. Chataway, 212 McIntyre Block, up to 6 o'clock p.m. on Saturday, the 21st day of August, 1909, for the construction of a sewer on Berlin Street, in D.G.S. 26 St. James, from the Portage Road to the Assiniboine River. Frank Ness, secretary-treasurer.

SHERBROOKE.—Tenders for fittings, Drill Hall, will be received until Wednesday, August 25th. Plans and specifications to be seen on application to Mr. J. W. Gregoire, supervising architect, Sherbrooke, and Napoleon Tessier, secretary, Department of Public Works, Ottawa.

QUEBEC.—Tender for Steam Roller, and addressed to the undersigned, will be received up to Wednesday the 18th inst., at 4 p.m., for a Steam Roller. W. D. Baillairge, city engineer.

**Ontario.**

COBALT.—The time for receiving tenders for the Cobalt waterworks and sewers has been extended to August 18th, 1909. (Advertised in the Canadian Engineer.)

COBALT.—Tenders for Passenger Station at Cobalt, Ont., will be received up till 12 o'clock noon, August 18. Plans and specifications may be seen and forms of tender obtained from John M. Lyle, architect, 14 Leader Lane, Toronto, and office of J. B. Clements, chief engineer, North Bay, Ont. A. J. McGee, sec.-treas.

KINCARDINE.—Tenders for Post Office and Customs Fittings will be received until August 26. Plans and specifications to be seen on application to Mr. Angus Kerr, Kincardine. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

OTTAWA.—Tender for a new steel steamer for the Quarantine Service will be received up to noon of the 13th day of September, 1909, for the construction of a steel steamer for the (salt water) Quarantine Service at Halifax, N.S., of the following leading dimensions, namely: Length, extreme 89 feet 3 inches; breadth of beam, moulded, 19 feet; depth, 10 feet; to be delivered at Halifax, in the Province of Nova Scotia. A. L. Jarvis, Department of Marine.

ST. THOMAS.—Messrs. Bell & McCubbin, civil engineers, will let a contract by auction on Saturday, August 14, for making a new road in the township of Yarmouth.

TORONTO.—Tenders will shortly be received by the City of Toronto for pole line supplies, conductors, poles, etc. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until August 17th, 1909, for asphalt pavements, bitulithic pavements, concrete pavements, concrete curbs, concrete walks and sewers. Joseph Oliver, Mayor.

TORONTO.—Tenders will be received until August 17 by the City of Toronto for asphalt pavements, bitulithic pavement, concrete pavements, concrete curbs, concrete walks and sewers. Joseph Oliver, Mayor.

TORONTO.—Tenders will be received by the undersigned up till noon Saturday, the 14th instant, for about 6,500 cubic yards of excavation for the University of Toronto. Plans and specifications may be seen and any other information obtained at the office of the architects. Darling & Pearson, 2 Leader Lane, Toronto.

TORONTO.—A quantity of pine and spruce timber situated in the Mississaga Forest Reserve, in the district of Algoma, having been partially damaged by fire, tenders are hereby invited for the right to cut said timber. Tenders will be received up to Wednesday the 15th day of September next. F. Cochrane, Minister, Department of Lands, Forests and Mines.

TORONTO.—Tender for Passenger Station at Cobalt, Ont., will be received up till 12 o'clock noon, August 18th. Plans and specifications may be seen and forms of tender obtained from John M. Lyle, architect, No. 14 Leader Lane, Toronto, Ont., and office of Chief Engineer, North Bay, Ont. A. J. McGee, secretary-treasurer, No. 25 Toronto St.

**Saskatchewan.**

ESTEVAN.—Tenders will be received until August 26th for heating apparatus. G. F. Faulkner, Estevan. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

REGINA.—Tenders will be received until Monday, August 16 for (a) trenching 22,800 feet for 18 inch C.I. pipe; (b) hauling 1,710 tons of 18-inch C.I. pipe; laying same and back-filling trench. J. Kelso Hunter, city clerk; Angus Smith, city engineer.

SASKATOON.—Tenders will be received until August 24th, 1909, for an 8-inch steam separator and a 500 horse-power open-feed boiler heater. J. H. Trusdale, city clerk. (Advertised in the Canadian Engineer.)

**British Columbia.**

FERNIE.—Tenders for Customs Fittings will be received until Monday, August 23. Plans and specifications to be seen on application to Mr. R. Kerr, clerk of works, Fernie. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

VICTORIA.—Tenders addressed to the undersigned from whom copies of the specifications may be obtained, will be received up till 4 p.m. on Monday the 16th day of August, 1909, for the supplying of cast iron water pipe, pig lead, gate valves. W. W. Northcott, purchasing agent.

## CONTRACTS AWARDED.

**Ontario.**

HAMILTON.—Contracts for building the following sewers were let: Little Peel Street, to J. Armstrong, 43 cents a foot; Wilson Street from Emerald Street to East Avenue, to A. Mercer, 74 cents a foot; Albert Road, to J. Armstrong, 47 cents a foot.

TORONTO.—In connection with the Hydro-Electric Commission's power line contracts were awarded to the lowest tenderers. The construction of the Toronto station will be done by Messrs. Witchall & Son, Toronto, for $36,500.

The London station will be built by Messrs. Hyett Bros., London, for $23,500. The contracts for those at Woodstock, Paris, Berlin, Stratford, St. Mary's, Preston, St. Thomas, and Guelph will be let next week.

TORONTO.—The contract for the erection of the stations of St. Mary's, Stratford, Berlin, and Guelph, were awarded to Messrs. Edge & Gutteridge, of Seaforth, at $18,700 each, while those at Preston, Paris, Woodstock, and St. Thomas, went to Mr. John Hayman of London, at $19,850 each. The contract for the supplying of 12,000 galvanized clamps to carry the cable was given to Messrs. Pratt & Letchworth, of Brantford, the lowest tenderers. The total price will be about $6,000.

**Saskatchewan.**

REGINA.—The water works committee accepted the tender of the Canadian Iron Corporation, Fort William, for 1,710 tons of 18-inch pipe at $40 per ton, 122 tons of 6-inch pipe at the same price f.o.b. Regina, and 8 tons of specials at $65 per ton. The contract for valves was given to the Canada Foundry Co., Toronto, and the contract for lead piping, curb braces, etc., to James Robinson, of Winnipeg.

**Foreign.**

COLUMBIA, N.J.—The contract for the construction of a hydro-electric development across Paulin's Kill, Columbia, New Jersey, for the Warren County Power Company; Meikleham & Dinsmore, Engineers, has been awarded to Frank B. Gilbreth, 60 Broadway, New York City. This contract includes the construction of a Ransom Hollow Dam, 30 feet high, and 350 feet long, as designed by Ransom & Hoadley, of Providence, R.I., a reinforced concrete power house and a tailrace.

CHICAGO, Ill.—The contract for building one thousand feet of reinforced concrete docks for the Deering Works of the International Harvester Company, of Chicago, has been awarded to the Raymond Concrete Pile Company, of New York and Chicago. W. D. Price, engineer. The docks are located along the north branch of the Chicago River.

## FINANCING PUBLIC WORKS.

**Quebec.**

THETFORD MINES.—$200,000 debentures for the construction of a waterworks and sewerage system are offered for sale by this municipality. Mr. Victor Morisset is secretary-treasurer.

WESTMOUNT.—Until September 1st for $435,000 bonds, William Minto, city treasurer, will receive tenders.

**Ontario.**

BRACEBRIDGE.—The by-law to raise $65,000 for developing additional water-power at Wilson's Falls has been carried.

BROCKVILLE.—A by-law calling for an expenditure of $16,000 for the construction of concrete bridges was defeated by a majority of forty-five.

CLINTON.—Tenders closed yesterday with D. L. Macpherson, treasurer, for $51,000 waterworks debentures.

LONDON.—On July 21st London was granted approval of plans calling for the extension of its water supply by a number of artesian wells.

LINDSAY.—Last Thursday the Provincial Board of Health visited Lindsay to look over the new ozonization plant.

OTTAWA.—Until September 2nd for $419,420, C. Hopewell, Mayor, will receive tenders.

PRESTON.—The ratepayers carried a by-law authorizing the purchase of Weinberg Park. The waterworks by-law was carried also.

PETERBOROUGH.—The ratepayers carried by-laws authorizing the erection of a new Milk Street Bridge and street extensions.

VICTORIA HARBOR.—The work on the 1st Section of the 12,000,000 bushel elevator being built for the C. P. R., by the J. S. Metcalf Co., is now in full swing. A force of over 350 men is busy excavating, blasting rock, building forms and filling concrete. The greater part of the footings are down and the foundation piers are well in hand. The J. S. Metcalf Co. expect to start on the tanks in about six weeks time.

**Saskatchewan.**

ALAMEDA.—Until August 16th for $15,000 debentures, J. P. Gordon, secretary-treasurer, will receive tenders.

RAINY RIVER.—Mr. Justice Britton has decided that the motion to continue the injunction in the action of Edward Reith against the Town of Rainy River must fail. The action was for an injunction to restrain the town from dealing with any money received from the issue and sale of waterworks debentures. The time for which the local Judge ordered the injunction expired, and his lordship holds that neither had the local Judge the consent of all parties nor was it shown that all the parties had solicitors residing in the district.

**Alberta.**

NANTON.—Until August 15th for $5,000 sidewalk debentures.

**Manitoba.**

BALCARRES.—Until August 17th $8,000 debentures, C. McMahon, secretary-treasurer, will receive tenders.

The following municipalities recently sold debentures: St. Louis, Que., $600,000; Weyburn, Sask., $75,000; Vegreville, Sask., $70,000; Windsor, Ont., $39,000; Strathcona, Alta., $162,308.58 local improvements.

**British Columbia.**

LADYSMITH. — The sewerage debentures have been sold, and Mr. Hugh MacDonald, who received the contract for the work of construction, commenced operations last week under the supervision of Mr. Myles Morley, City Engineer.

VANCOUVER.—The Waterworks Committee has decided that $350,000 must be raised by debentures to complete the work within next year and cover an overdraft of $130,000.

## RAILWAYS—STEAM AND ELECTRIC.

**New Brunswick.**

ST. JOHN.—It is stated that the contract for the construction of the Tobique and Campbellton Railway, in New Brunswick, will be let early this fall, and that work will commence on it before winter. The new railway, which is practically an extension of the Tobique Valley road from Plaster Rock to Riley Brook will be operated by the Canadian Pacific Railway Company, under terms similar to those under which that company operates the Tobique Valley road. The new road will run along the west bank of the Tobique River through a thickly settled district.

**Quebec.**

MONTREAL.—Sir Charles Rivers Wilson, president of the G.T.P., goes to Stratford and Battlecreek to inspect the shops and then to Chicago, Seattle, Victoria, Vancouver and Prince Rupert, returning east over the G.T.P. from Edmonton to Fort William, thence by boat to Sarnia. He expects to be back in England by the end of September. Asked if he thought that the critical period in the construction of the G.T.P. was now over, he said that there never had been a critical period, only such difficulties as great enterprises might expect. Now they have ample money to construct the most difficult portion in the Rocky Mountains. Sir Charles denied that there had ever been any agitation in London for a Canadian board for the Grand Trunk, saying that only one or two obscure individuals had raised the question.

**Manitoba.**

WINNIPEG.—Tenders for the construction of the G.T.P. grade from Copper River east to Aldermore, a distance of 130 miles, the second section east of Prince Rupert were opened on August 9, but the contracts were not awarded. It is estimated that a million and a half yards of rock

will have to be moved, which will cost about four and a half million dollars. The completed section will cost about six millions. No announcement of the successful tender was made. Announcement is made by the traffic officials of the G.T.P. that owing to the exceedingly heavy rains in the far west, which have delayed ballasting and otherwise affected the track, the through passenger service to Edmonton, which was to have gone into effect next week, will not be inaugurated until some time in September.

**Alberta.**

EDMONTON.—The Grand Trunk Pacific Railway steel gang, working two eight-hour shifts, is now well on the way from Edmonton to the Pembina River, sixty-eight miles west of Edmonton. Until the rails reach the river they cannot go on with the big Pembina bridge, which is to be a thousand feet long and two hundred feet high. Owing to the dearth of tall timber on the Pembina, the material for the false work used for constructing the Battle River bridge and the Clover Bar bridge will be forwarded and used at the Pembina, the superstructure for this high bridge is completed.

**British Columbia.**

NELSON.—For the past few days there have been reports of a race between the C.P.R. and Canadian Northern surveyors for a route down the Fraser, where it appears that the C.P.R. wants the south bank as well as the north. Engineer Bassett is in the Coquihalla with a large force of men and the belief is that it is the C.P.R. he is working for. With the link from Midway to Nicola connected up and a route down the Coquihalla to Hope the C.P.R. would practically have all the Boundary-Coast passenger traffic.

## LIGHT, HEAT, AND POWER.

**Ontario.**

LONDON.—A party of the Hydro-Electric Power Commission's men, under Engineer Clark, of Toronto, are here laying out the line between London and Stratford.

TORONTO.—In connection with the new Hydro-Electric power line the construction of the stations at Dundas and Niagara is already proceeding, and it is anticipated that they will be completed by December. The towers and telephone lines on the right-of-way of the transmission line are being rapidly put up. Two construction gangs are now working on the erection of towers and a third will be added next week, when it is expected that it will be possible to erect fifteen towers per day.

**Alberta.**

MEDICINE HAT.—The Brydges Engineering & Supply Company, of Winnipeg, are installing one of their Daniels gas engines for R. Mitchell. The engine will work with natural gas and will be used in a refrigerator plant.

## SEWERAGE AND WATERWORKS.

**Ontario.**

HAMILTON.—City Engineer Macallum has estimated the cost of building the new west end sewer at $27,000.

LONDON.—The Council having finally passed the water by-law to expend $123,700 for the artesian wells, pumping plant and new mains, it is now proposed to combine the water and power distribution plants on Horton Street, effecting a saving estimated at $4,000 per annum.

**British Columbia.**

CRANBROOK.—The policy of the Cranbrook Municipal Council to acquire the ownership of public utilities has just been endorsed by an overwhelming vote in favor of their taking over the waterworks plant at a cost of $70,000.

## TELEPHONY.

**Quebec.**

MONTREAL.—Estimates have been approved for increased facilities on the Bell Company's system as follows:—Exchange—Aerial—Port Hope, Gananoque. Rural Lines—Peterborough—Stewart, Toronto Township, Milliken, Wolfe Island. Underground—Port Hope—conduit and cable, Berlin—conduit, Ottawa—conduit, Toronto North—cable, Smith's Falls—conduit and cable, Three Rivers—conduit and cable, London—conduit. Long Distance Lines—Lindsay—Fenelon Falls, Rodney—Ridgetown, Lennoxville—Cookshire, Ste. Martine—Huntingdon, Jeune Lorette—St. Catherine, Que.

**Manitoba.**

WINNIPEG.—There are no fewer than 3,000 odd applications to the telephone commissioners for extensions of rural telephones. Construction work is being rushed forward all the time. The Turtle Mountain system has now been turned over to the Government. The Melita Arthur Telephone owners have applied to the Government to purchase their system, which is composed of telephone exchanges in the towns of Melita and Lyleton, and rural lines throughout the rural municipality of Arthur.

## CURRENT NEWS.

**Nova Scotia.**

SYDNEY.—The United Coke Company of New York have secured the contract for the erection of a number of coke ovens for the Dominion Iron and Steel Company and the work will be started immediately. The number of ovens to be constructed is 120. The new oven is of a different type and has a much greater capacity for coking than the old ones

**Ontario.**

ALEXANDRIA.—The town council has decided not to open the tenders which had been received for the construction of the five-foot granolithic walk—nearly 3,000 feet in length. The plans and specifications were prepared by Mr. E. Perrault, C.E., of Ottawa. The council decided to return the tenders to the interested parties, amend the specifications, and call for new tenders.

OTTAWA.—The engineers intrusted with the drafting of plans for the new Quebec Bridge are expected to meet in Quebec on August 6 to confer as to their final report to be made to the Minister of Railways. It is hoped that the plans for the new structure will be completed in time to allow of calling for tenders early next winter.

PETERBORO'.—Popular voting took place July 29 on two by-laws. One is to raise $32,500 to build a reinforced concrete bridge over the river at Smith Street, which carried by a majority of 139, and the other to raise $21,500 for street extensions and filling the waterfront, secured a majority of 148.

**British Columbia.**

VICTORIA.—Applications are being invited for the position of chief water commissioner, from civil and hydraulic engineers, the salary offered being $250 per month. These will be received up to and including Saturday, August 14th, by the Chief Commissioner of Lands.

**Foreign.**

MILWAUKEE, WIS.—The Cutler-Hammer Mfg. Co., of Milwaukee, makers of electric controlling devices, announces the opening of a Philadelphia Office, Room 1207, Commonwealth Building, and an engineer specially qualified to advise regarding the control of electric motors will be in charge of the new office.

## PERSONAL.

MR. ROBERT W. GRACE, formerly Superintendent at the Canada Foundry, Toronto, has left to assume his new duties as General Superintendent of the Platt Iron Works Company, of Dayton, Ohio.

MR. J. F. B. VANDELEUR, accompanied by H. O. Sidderley, of the Manchester Dynamo and Motor Co., of Trafford Park, Manchester, England, sailed for England on the steamship Empress of Britain to-day.

MR. W. G. SWAN, B.A.Sc., formerly of the Canadian Northern Railway engineering staff in British Columbia has now charge of a party for the London and North-Western Railway in Western Ontario.

MR. WILLIAM MARSHALL, who has been connected with the Canadian Pacific Railway Company's telegraph service for the past twenty-three years, has been appointed superintendent of the Ontario division of C.P.R. Telegraph line.

MR. A. K. GRIMMER, B.A.I., formerly City Engineer of Fredericton, N.B., has been appointed Lecturer in Civil Engineering in the University of Manitoba, as assistant to Professor E. Brydone-Jack, head of the Engineering Department, of the University.

Mr. Grimmer is a native of St. Andrews, N.B., and graduated as civil engineer from the University of New Brunswick in 1905. He won two prizes at the university, for the best summer thesis on engineering subjects. For a short time he acted as assistant professor at the New Brunswick University, and later received the appointment of City Engineer at Fredericton, N.B. From this position he comes to take the position of Lecturer in Civil Engineering at the University of Manitoba. Mr. Grimmer had a distinguished career and has had considerable experience in railway work, and will undoubtedly be a valuable acquisition to the engineering staff of the Manitoba University.

MR. WILLIAM WHYTE, second vice-president of the Canadian Pacific Railway, and executive head of their western lines, has almost reached the age at which his retirement might be expected, but so valuable have been his services, so highly is he esteemed by the company, and so popular and universally respected is he, particularly in the West where he is best known, that his term of office has been extended for two years.

Mr. Whyte was born in Charleston, Fifeshire, Scotland, September 15th, 1843. He was educated in the schools of his native town, and in 1861 entered the employment of the North British Railway Company. In 1863 he emigrated to Canada, and in 1865 he received the appointment of freight clerk on the G.T.R. at Cobourg, Ontario. In the same year he was transferred to the company's freight office in Toronto, occupying a similar position till the early part of 1867, when he became freight foreman of the sheds. He afterwards occupied the position of yardmaster at Toronto, and in 1870, was appointed night station agent at the same city. A year later, in 1871, he was at Stratford, occupying the double position of freight and station agent.

He held the appointment until 1874, when he was promoted to similar appointments at London, remaining there until 1881, when he was recalled to Toronto to take charge of the freight offices in that city. Before the end of the year, he was again promoted, this time to be assistant superintendent of the central division, extending from Kingston to Stratford, and including the Galt and Waterloo branches. In May, 1883, he left the service of the G.T.R., to accept the position of general superintendent of the Credit Valley Railway, in succession to James Ross, C.E. In October of the same year, the Credit Valley Railway and Toronto, Grey and Bruce Railway became portions of the Ontario and Quebec system, afterwards designated as the Ontario division of the Canadian Pacific Railway. The management of the united road, and also of the Ontario and Quebec Railway, when completed, fell under Mr. Whyte's direction, and he became an official of the Canadian Pacific Railway, with the position of general superintendent of all C.P.R. lines in Ontario west of Smith's Falls. In May, 1885, the eastern division, extending to Quebec in the east and Port Arthur in the west, was added to his jurisdiction. In October, 1886, he was appointed to be general superintendent of the western division, with headquarters at Winnipeg. In May, 1897, he was again promoted, being appointed manager of all the Canadian Pacific lines between Lake Superior and the Pacific Coast. In 1901, he was appointed assistant to the president and relieved from all routine work in order to look after the extension of the system in the West. In furtherance of this duty, he in 1901 made a trip through Russia over the newly constructed Trans-Siberian Railway, and in 1903 he was appointed second vice-president of the C.P.R. Mr. Whyte is vice-president of the Winnipeg Street Railway, vice-president of the Standard Trust Company, a director of the Confederation Life Association, and a director of the British Columbia Southern Railway.

## LATE CONSTRUCTION NEWS.

**Ontario.**

NAPANEE.—A new bridge with concrete abutments and a steel superstructure is suggested by F. F. Miller, C.E., to replace the old covered bridge here. An 18 foot roadway is proposed, with a 4 foot walk on each side. The plan will likely be carried out this fall at a cost of several thousand dollars.

SAULT STE. MARIE.—The Lake Superior Corporation will commence the work of building their new blast furnaces and merchant mill next week. When completed the work will represent an expenditure of $50,000 and will require from one to two years for completion. The H. E. Talbot Company, of Dayton, Ohio, are the contractors.

WINNIPEG.—The Brodesser Elevator and Manufacturing Company, of Milwaukee, are making arrangements to establish a branch in Western Canada. They will form a Canadian Company and build a large warehouse in Winnipeg, which they expect to have in operation some time this fall. The Brodesser Company have installed a large number of elevators in Winnipeg, as well as at points throughout the West, and now find their business in Canada increasing to such an extent that it is necessary to establish an up-to-date plant here.

(Continued from Page 171.)

of air explosions are the presence of an explosive mixture and an air temperature sufficiently high to ignite the mixture. These are sub-divided into many parts:—(1) Too high inlet temperature; (2) inefficient inter-cooling system; (3) defective cylinder jacketing; (4) failure of a too high initial temperature of circulating water; (5) inferior lubricant; (6) dust (particularly coal dust) entering cylinder with the air; (7) leaky outlet valves; (8) failure to clean inter-coolers, receivers, pipes, etc., at reasonable intervals.

As five of the eight contributory causes also affect the mechanical efficiency of the plant, and the others affect the maintenance costs, they should all be absent from well-operated plants. The installation of efficient pre-coolers, the increase in cooling surface of inter-coolers, the ample supply of cold circulation water, and the use of a high-grade lubricant, would remove practically all the causes of explosions, and would, at the same time, tend to greatly increase the capacity and efficiency of the plant. Air should go to low-pressure cylinders many degrees below outdoor shade temperature, and should not go to high-pressure cylinders at above atmospheric temperature, otherwise there is grave danger of excessive temperatures being reached at termination of compression.

In conclusion I would state that the intelligent consideration of the various problems connected with air compression must tend to higher efficiencies, a decrease of the liability to explosions, and the production of a more sanitary air for use in underground workings. It should also tend to reduce the worries of the resident engineer, who suffers because he has not the necessary equipment.

## MARKET CONDITIONS.

Toronto, August 12th, 1909.

A cablegram of Monday last from Glasgow stated that orders for large quantities of fire-clay bricks for the erection of additional iron furnaces in America and Canada have been given out to Scottish makers. This was interpreted to mean a boom in the "American" iron and steel

trades. People in the States have been trying to see, and indeed to work, a boom in those trades for months, which, however, is slow to arrive. But a boom in Canadian iron-smelting circles is a different proposition.

Old Country metal markets of to-day show activity. On yesterday there was quite a flurry. Quotations of Straits tin in London, which were £133 10s. spot on 9th, were £135 17s. 6d. on 10th, and £134 7s. 6d. firm on 11th; copper, on same three days, was quoted £58 13s. 9d.; £58 15s.; and £59, being excited on Wednesday, Middlesbro pig-iron has shown trifling advances during the week.

Bricks are active still, stone steady, and lumber firmly held, building within the city being remarkably brisk. Cement continues in over supply, every mill being apparently over-produced. Whether there is or is not anything definite in the much-talked-of merger, it is certain that at least two very large producers are not "in it," and that there is no resultant stiffness in the market.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Season over, nothing doing.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, and sales have been made within the month at 5c. less than this. Until the consumption increases, prices will not improve. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market outside is higher and was excited yesterday. But we quote still $13.85 to $14.05 in this market, with a fair movement.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—The local demand for stuff is maintained, but there is not so much doing outside. Southern pine continues to move, and the stock on hand is depleted. Spruce flooring is not so much heard of here, since better prices can now be had for spruce at home in New Brunswick and Quebec. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—More demand during the past few days, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 6.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—After some ups and downs this week the London market showed an advance. We still quote 31c. to 31½c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $31.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.80 to $1.85; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, new, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, 7½ to 9c.; fancy, 11 to 12c.; extra fancy, 14½ to 15c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 7½c.

**Eggs.**—New laid, 22 to 23c. per dozen, in case lots.

**Lard.**—Stocks are light. Tierces, 14¾c.; tub, 14¾c.; pails, 15c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Short cut, $25 to $26 per barrel; mess, $23.50.

**Potatoes.**—Ontario, old, 75 to 90c. per bag in car lots on track.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 13¾c. to 14c.; firm, tons and cases; hams, large, 13 to 14c.; small, 15½ to 16c.; rolls, 13 to 13½c.; breakfast bacon, 17c.; backs (plain), 18c. to 18½c.; backs (peameal), 18½c. to 19c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.70 per 100 lbs. in barrels; Acadia, $4.60; yellow, $4.30; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 18 to 35c .per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Montreal, August 12th, 1909.

In the United States, all the iron and steel markets are tending upwards. The tariff is now definitely settled, but, for the most part, Canada is little affected. It is stated that the duty against foreign pig-iron has been fixed at 15c. instead of at 40c., as formerly. In that case, such companies as the Dominion Iron and Steel, Algoma Steel, and perhaps more particularly Nova Scotia Steel and Coal, in which is understood to be making a specialty of ore exporting, should be enormously benefited by the change. Demand throughout the market is generally quieter than for some time past, but this in no way weakens the market, prices being firmer than for a long time past, under the circumstances. The general feeling is that advances will take place before much longer. As soon as the dull season is past, the market will likely become very active.

The situation in England and Scotland is more hopeful than for months past. In fact, cables have just been received announcing advances of 1/6 on pig-iron. The recent troubles threatened by the impending coal strike seem now to have disappeared, and while there is little improvement in demand from the continent, there is a very much better trade in the home market. Demand from Canada, also, shows an improvement, a few orders being in for fall delivery, already.

In the local market, trade is rather quiet. Orders are beginning to come for delivery before the close of navigation, and the feeling is spreading that it would be wiser to make purchases at the earliest possible moment in case prices should advance. The opinion is expressed here that prices on pig-iron will advance before the end of the month.

In other lines, such as finished and semi-finished material, no changes are taking place, the alterations of a week ago having been succeeded by great steadiness. The market is quoted as follows:—

**Antimony.**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags repurchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

**Coal and Coke.**—Antoracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; caonel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 13¾ to 14c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blastiog powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platioum, siogle strentgh, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less thao case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and Englisb 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, on dock, Montreal: No. 1 Summerlee, $20; selected Summerlee, $19.50; Clarence, $17; Midland or Hamilton pig is quoted at $19.50 to $20, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50; Carron soft, $19.25.

**Lathe.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.55 to $3.65.

**Lead Wool.**—$10.50 per huodred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $22 to $25. Spruce, 1-in. by 4-10. and up, $16 to $18 per 1,000 ft.; mill culls, $14 to $16. Hemlock, log run, culls out, $14 to $16. Railway Ties; Standard Railway ties, hemlock or cedar, 35 to 45c. each, on a 50 rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per galloo; girder, bridge, aod structural paint for steel or iron—shop or field—$1.20 per galloo, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvaoized; ⅜-iocb. $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-iocb, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotatioos on steel rails are oecessarily only approximate aod depend upoo specificatioo, quantity and delivery reqoired. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to coodition of rail aod location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofiog).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.30 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; aod No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32 to 32½c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

* * * *

Winnipeg, August 10th, 1909.

The western market continues to be fairly brisk, and the large amount of building going on makes business with the supply houses particularly good, and they are kept on the rush filing orders.

There is no special demand for any one line, but a general steady tone pervades the market. The number of building permits continue to grow, and this will undoubtedly be a record breaking year as far as building permits go. All prices in the local market are steady, but as mentioned in previous reports, no anxiety is felt in regard to the price of coal and also as to the supply. Machinery dealers throughout the country are very busy just now, also the local iron foundries, as the farmers are getting everything in readiness for reaping the immense harvest of the Western prairie.

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Quotations on the Winnipeg market are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; caonel coal, $10.50 per ton; Galt coal, $8 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coppered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, siogle, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hair.**—Plaster's, 80 to 90 cents per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4½c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

**Picks.**—Clay, $5 dozen; pick mattocks, $6 per dozen; clevisbes, 7c. per lb.

**Pipe.**—Iron, black, per 100 feet. ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.25; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

**Pitch.**—Pine, $6.50 per barrel; in less thao barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c.; sisal, 10½c.

**Spikes.**—Basis as follows:—1¼ x 5 and 6, $4.75; 5-16 x 5 aod 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 100 lbs.

**Timber.**—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Tool Steel.**—8½ to 15c. per pound.

**Wire.**—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 gauge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.

# The Canadian Engineer

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## The Canadian Engineer

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Everything affecting the editorial department should be directed to the Editor.

**NOTICE TO ADVERTISERS**

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## RAILWAY SIGNALLING.

In recent issues of our journal we have been fortunate in securing for publication a few articles on Railway Signalling. These articles have outlined modern methods of protection, and in some cases emphasized the necessity for such protection.

Two kinds of protection are most urgent. First, the public require protection against their own thoughtless acts; and second, the travelling public require protection against the mistakes and carelessness of railway employees. It is to the protection of the second class that the term "Railway Signalling" has become more definitely attached.

A study of the railway accidents in Canada leaves the impression that the public require more protection against their own carelessness than against the mistakes of employees. Three times as many people are killed when trespassing on the track than in all other railway accidents combined. The deadly highway crossing, the open switch, the neglected semaphore and the "I forgot," all combined, cannot tell such a tale of death as does the total of killed when trespassing.

We hear a loud call for subways and viaducts, but if we would encourage and assist the railways in enforcing a "No-trespassing-allowed" law it would be very much more to the point. To secure the enforcement of such a law, more educational work will have to be done, just as it requires much compaigning to prevent people from attempting to board or alight from moving street cars and railway carriages.

Railway signalling is a new art—an art becoming more highly developed and more successful in its application daily. In Canada, we have given the matter but little attention. But public opinion is demanding a higher degree of safety, and railroad officials see the possibility of lessening the loss to rolling stock, decreasing the running time and adding to the safety of employees and passengers by adopting the best methods of signalling and train control.

The number of devices offered for this work is legion. Each week sees one or more new devices patented for which all sorts of ridiculous claims are made, but the useless and unpractical are soon weeded out—a good example of the survival of the fittest.

All the systems devised fall into some one of the following classes: Systems worked without track circuits; systems controlled by track circuits complete in each block; systems with track circuits covering the division.

The perfect system is not yet invented, but signal engineers are improving the practical systems, adding to their knowledge and experience, and they and their inventions are more anxiously sought after.

## A DEPARTMENT OF IRRIGATION.

The closing session of the Western Canada Irrigation Convention was marked by the adoption of a number of important resolutions—resolutions which were a sort of confession of faith of the leaders in irrigation work in the three Western Provinces.

That Alberta needed an agricultural college they were certain, and that the college should be located in the irrigation belt was their dearest wish.

Millions of money was being spent on irrigation schemes. Thousands of settlers are coming to live on the semi-humid lands, and if the best results are to be secured the Government must carry on experiments, distribute literature, and train in their own fields the young men—their young men—anxious to be a successful agriculturist or horticulturist in the irrigated lands belt.

It is to be hoped that Alberta will so locate her Agricultural College that part of the farm land may be irrigated. Raw land in the fertile valleys of the West is now worth from one to two hundred dollars per acre. Even on the great plains the capital invested is so large that only intense farming will bring satisfactory results. It is, therefore, necessary that instruction be given in the practice and theory of the artificial application of water to crops.

As yet we are not educated in irrigation matters. A few of the large farmers and a very few engineers have made some progress in the art in Canada, but the great body of producers are ignorant of the best methods, and every facility ought to be offered so that they may secure the best technical training, and thus be able to make the most of their opportunities.

## RAILWAY COMMISSIONERS' SITTINGS.

The Board has decided to postpone the Operating Sittings, fixed for Ottawa, Ont., Tuesday, September 7th, to Tuesday, September 14th, 1909, at the hour of ten o'clock in the forenoon.

The date for the September Traffic Sittings remains unchanged, and traffic matters will be heard at Ottawa, Tuesday, 21st September, at the hour of ten o'clock in the forenoon.

## GRAND TRUNK CANADIAN DIRECTORATE.

(The Monetary Times.)

Sir Charles Rivers Wilson at Montreal last week gave a shower bath to the Canadian-directorate-for-Grand-Trunk proposal. Every year at the annual meeting the proposition, together with Mr. Fairbairn, a strenuous and eloquent pleader, receives a similar cold douche. Sir Charles stated that no one of weight favoured the innovation. He probably forgot that Sir Robert Perks recently numbered himself as an "Aye," while many prominent business men in London, Montreal, Toronto and Winnipeg would like to witness the change. The Grand Trunk's president sees no objection to a small board of Canadians here. This, we take it, is the proposal. That, and the listing of Grand Trunk stocks on the Canadian Exchanges as suggested by the Monetary Times, would undoubtedly help sentiment so far as it concerns the road. Sentiment is a consideration in relation to earnings. The best way to succeed is to stop harmful discussion. The Canadian directorate will be talked until it comes. The sooner it arrives, the quicker will the chatter cease and will folks get down to business proper.

## EDITORIAL NOTES.

The Canadian Forestry Association are holding a special meeting at Regina, Sask., September 3rd and 4th, 1909. The subjects dealt with will refer particularly to conditions in the Prairie Provinces, and will embrace: Tree Planting on the Eastern and Western Sections of the Prairies, Forest Reserves, Game Protection, Growing Wood for Fuel and for Windbreaks, and the Relation of Forests to the Conservation of Moisture. The speakers will include the best-informed men on forestry subjects in Canada.

The Toronto Street Railway's daily average receipts amount to over one hundred thousand dollars per day. The city's income from their percentage of earnings amounts to over two thousand dollars daily. This is over twice as much as they received from this source five years ago.

## PERSONAL.

MR. E. RICHARDS, B.A.Sc., of the Electrical Department, City Hall, Toronto, is now on a business trip to Great Britain.

MR. PHELPS JOHNSON, chief engineer of the Dominion Bridge Co., Montreal, Que., and Mr. Paul Wolfel, chief engineer of the American Bridge Co., have been called in in consultation by the Quebec Bridge Commission in reference to the plans for the superstructure of the Quebec Bridge.

MR. BENJAMIN R. WESTERN and W. Hull Western, Mr. Walter Mueller and Mr. W. H. Denney have formed the Manufacturers' Publicity Corporation, with offices in the Hudson Terminal Buildings, 30 Church Street, New York.

DR. R. K. McCLUNG, who for the past two years has been in charge of the Physics Department of Mount Allison University in Sackville, N.B., has resigned to accept an appointment to the physics staff of the University of Manitoba in Winnipeg. Dr. McClung is a graduate of McGill University, and after graduating was appointed to a position on the physics staff of that institution. He later spent three years doing research work in physics at the Cavendish laboratory, Cambridge, England, after which he returned to again join the staff of McGill, where he remained until appointed to the professorship of physics in Mount Allison. During the past year he has been engaged on the writing of a college textbook on one of the modern branches of physics, which is at present in the hands of the publisher, and is expected to appear this fall. He takes up his duties in Winnipeg at the beginning of October.

SIR WILLIAM HENRY WHITE, K.C.B., who from 1885 till 1902 was the responsible designer of all the war vessels for the British navy, is in Toronto. Sir William is on his way to Winnipeg, where he will deliver an address at the meetings of the British Association for the Advancement of Science. In addition to having served as president of the Institutes of Civil Engineers and Mechanical Engineers, and as vice-president of the Institute of Naval Architects, Sir William has also written extensively upon professional matters. His chief works are "A Manual of Naval Architecture" and "A Treatise on Shipbuilding." Sir William and his party will remain in Toronto for several days. At present they are in residence at the King Edward.

MR. D. M. SAXBY, of Toronto, has been appointed electrical engineer by the city of Prince Albert, Sask.

MR. T. L. PRENTER, who has been with the C.P.R. for twenty-four years, has accepted the position of assistant manager of the British Columbia Electric Railway. He will have special charge of the Chilliwack branch.

MR. F. C. ARMSTEAD, supervising engineer of the stoker department of the Westinghouse Machine Company, who, for a number of years, has been located at East Pittsburg, Pa., has moved his headquarters to the Westinghouse Works, Attica, N.Y., where the stokers are manufactured.

**The First to Reach us at the Three Dollar Rate**

We would like to publish the complete list of $3 subscribers but have only space for the first, which was received from an unknown friend away in the West.

The Canadian Engineer,
Toronto, Can.

Dear Sirs,—

Please find enclosed Three Dollars [$3] for 1 year's subscription to the "Canadian Engineer."

Yours truly,
Norman M. Hall, B. Sc.

G. T. Pacific
Rivers, Man., Aug. 12, 1909

## ELECTROLYSIS OF WINNIPEG WATER MAINS.

**Louis A. Herdt, Ma. E.E., Professor of Engineering, McGill.**

Pursuant to the resolution of the Council of the City of Winnipeg, which appointed me under date of Jany. 5, 1909. 1909, to report upon the electrical conditions in the City of Winnipeg, particularly in connection with return current of the Winnipeg Electric Railway Company's system and their connection with the Government Telephone Cable System. to report upon the electrical conditions existing in the City of fire standpoint and to submit recommendations dealing with improvements of the present system so that any electrolysis or fire risk, if such exists, may be eliminated, I have the honor to present herewith the following report:

The Winnipeg Electric Railway Company, in operating their street railway system, use the rails as a return for the current operating the cars. In order to make the rails a continuous conductor and thus secure a good return path for the current, the rails are bonded at the rail joints with

copper bonds, besides this the rails are connected to the station negative bus bars by return copper feeders, bonded to the track at different points of the system.

This is the usual method of street railway return construction, but electric railway companies using this system, that is, using the rails as the return circuit for the returning currents, are a serious menace to piping and cable systems in proximity to the tracks, if the methods of constructing the above described rail returns are such that the railway companies are unable to control their own currents, but use the piping and lead-covered cables as part of their return circuit.

### Cause of Electrolysis.

Currents from the railway system, if the track returns are in bad condition, having to find their way back to the power house, will flow from the rails which are in contact with the ground, through the ground and such metallic constructions in it as offer the least resistance to the flow, and after flowing through these (gas pipes, water mains, lead-covered cables, etc.) towards the station, will return through the ground, back to the rails to return conductors in the vicinity of the power house. These stray currents cause electrolytic action, that is, wherever current passes from a pipe or cable to ground, or to another pipe or cable, corrosion of the metal is set up; holes and pittings are produced, causing bursting and leaking of pipes, eating away of the lead-covering on telephone and other cables, rendering them useless. This corrosion may be very rapid and depends on the intensity of the stray currents passing through.

If the rails in a track system were continuous and the current density in the rails kept low, with rails well connected to the power house, the rails would offer such a good return path for the current that street piping, cables and other metallic structures would be practically immune from electrolytic damage due to stray currents. However, as the rails are not continuous but made up in lengths, they must be jointed by copper bonds possessing such mechanical and electrical properties as will secure permanent and efficient electrical continuity of the rails between sections. If such bonding does not exist, and if return feeders connecting the rails to the power house are inadequate for the purpose, the amount of leakage current must be great and electrolysis is bound to exist. The immunity of street piping and other metallic structure from electrolytic damage due to stray currents demands that electric railway companies adopt such method of construction for their track returns as will minimize the danger and the railway companies must maintain the efficiency of such construction through systematic inspection and repair.

In view of the above and in order to arrive at correct and definite conclusions regarding the conditions existing in the City of Winnipeg, a survey for electrolysis and examination of the track piping and cable systems was made.

### Plans Prepared.

Drawings were made as follows:—

Plan No. 1 showing electric railway tracks, high pressure water mains, domestic mains, gas mains, telephone cables—City of Winnipeg. Only those close to or paralleling railway tracks are shown.

This plan also shows districts affected by electrolysis.

Plan No. 2 shows also present lay out of feeders and sections—electric railway tracks, weight of rails, return feeders, bonds, etc.

Plan No. 3 showing localities where damage to water pipes by electrolysis has taken place (from reports of F. A. Cambridge, Esq., city electrician).

### Description of System.

The Winnipeg Street Railway Company have two plants in the City of Winnipeg—one, the old steam plant at the foot of Main Street, corner of Assiniboine Avenue; the other, the sub-station on Mill Street. The first plant is kept as a steam reserve; the second plant, which furnishes the whole of the electric current for the street railway system, receives its electrical energy from the hydro-electric plant at the Pinawa Channel of the Winnipeg River. The average current for the railway service fed out from this plant approximates 6,000 amperes, but reaches as high as 9,000 amperes at times of heavy load in the winter months.

The street railway tracks are bonded at the corner of Main Street and Portage Avenue to return feeders connected to the negative busbars at the station. Other return feeders connected at different points to the track are also used (see Drawing No. 2).

It was apprehended at once from a study of the geographical location of the power station, its distance from the street railway tracks, the large volume of current that required to be returned to it, the run of the underground piping system and the telephone cables (see Drawing No. 1) and the proximity of the river, that unless the track returns were of the very best, and unless there was a very generous amount of copper used for the negative feeders, the conditions were such as to point to great possibilities for stray currents.

### Electrolysis Investigation and Survey.

The electrolysis survey which was carried out, involved not only mere readings of potential difference between the rails, the piping system and telephone cables, but it embraced an examination of the feeding circuits, the general

condition of the roadbed and the size and efficiency of the return. A complete and thorough examination of the points where the city electrician had reported damage to the pipes was also made.

The following summary states concisely the conditions existing in the city.

### District Affected by Stray Currents.

The report of your city electrician, a copy of which is attached (Exhibit D), giving location of pipes damaged dating from January 1905 to June 4, 1909, shows that electrolytic action has mainly taken place in the following districts:—

1st—Princess Street, from Logan Avenue to Notre Dame Avenue.

2nd—Portage Avenue, from Hargrave Street to Forth Street.

3rd—District enclosed by Main, Broadway, Hargrave and the river.

4th—Notre Dame Avenue, from Main Street to Winnipeg Electric Railway Company's sub-station.

5th—Ellen Street, from Notre Dame Avenue to McDermot Avenue.

6th—Langside Street, from Portage Avenue to Ellice Avenue.

(These districts are shown shaded on Drawing No. 1.)

Pieces of water pipe and lead covered cables taken from these districts by Mr. Cambridge were examined and showed without doubt that holes and breaks in them had been caused by electrolytic action. (Photos of these attached.)

The damage reported in districts Nos. 1, 2, 5, and 6 is caused by the very bad condition of the bonding on Portage, Notre Dame and William Avenue and Sherbrooke Street tracks. On Portage Avenue, from Hargrave Street towards Sherbrooke, where the roadbed is unpaved, the bond wires, which are Nos. O, B, and S, soft copper wire with bonding cap terminal, give readings in equivalent feet of rail of 20 to 60 feet—this shows very bad condition of bonding. (Readings are given in Exhibit A.)

At several places the bonds are uncovered and many broken bonds were noticed. Current is leaving the tracks in Sherbrooke Street, South Portage and Notre Dame west of Sherbrooke (rails are positive to pipes), entering the pipes, flowing down these until close to Main Street is reached (along Main Street from river to C.P.R. subway, pipes are positive to rails), the current leaves the pipes to rails, telephone cables on other pipes causing the damage reported—it accounts also for the trouble reported in the T. Eaton Company's store. (Report of city engineer, March 2, 1909.

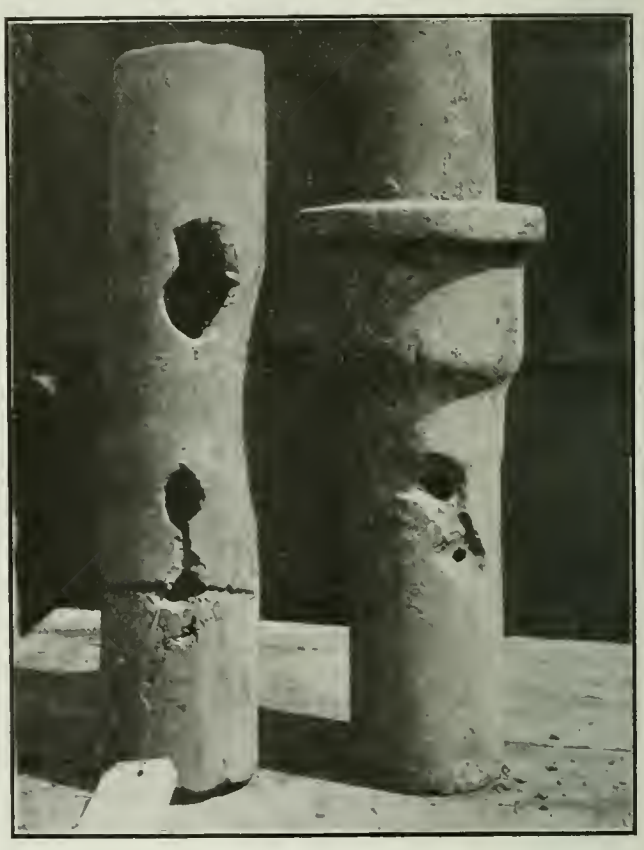
In connection with district No. 3, that is, in the district around the car barns on Main Street close to the river, the rails on Main Street are bonded to the water pipes. The heavy water mains on this street carry a large part of the railway current till it reaches Water Street, Notre Dame Avenue and Portage Avenue East, that is, district No. 4, the stray currents are here given back to the telephone cables which are bonded to the negative bus-bars of the sub-station on Mill Street and also to the intricate network of mains and service pipes lying in this district. This accounts for the trouble reported in the McIntyre Block. In this connection, the writer desires to state that on May 26 in company with the city electrician this building was visited. In the basement a recording amperemeter was connected between the water main and the telephone cable. Charts of current readings were kept. At the time of the visit 50 amperes were recorded and the water pipe was positive to the telephone cables. With the statement reported by your city electrician that such a condition involves danger of fire, the writer does not agree, although the conditions there are remarkable enough that conditions might be assumed under which fire could be possible. The remedial scheme referred to above, that of bonding the tracks with water and gas pipes, although it may afford local protection and was considered good practice some time ago, will greatly increase the amount of stray currents and should not be encouraged.

The bonding of the tracks on Main Street from the river to the C.P.R. subway is good. (Readings are given in exhibit "E.") In addition to the rails which are heavy (70 and 95 lbs. to the yard), a 500,000 c. m. cable runs between the rails and is cross bonded to the track. On account of the bad condition of the track returns in the other parts of the city causing stray currents everywhere, the tracts on Main Street, connected to the bus-bars through heavy copper returns, draw the currents from the piping along this street. This is shown by the electrolysis survey, as readings taken along this street between the high pressure hydrants and domestic water pipes show these positive to the rails. As a matter of fact throughout the whole centre of the city this condition is met (see drawing No. 3).

It can therefore be stated that electrolysis is taking place through the entire centre of the city.

### Return Feeders.

The tracks are bonded at the corner of Main Street and Portage Avenue to the return feeders of a total sectional area equal to 6,848,000 circular mills. The drop of potential between this point and the negative bus bars, if these carried the whole railway current would reach 12 volts at



times. The distance is approximately 1,200 feet, that is, the drop of potential from these tracks to the station is one volt per 100 feet. This is altogether excessive, a voltage drop of one-half volt per 300 feet is usually considered large enough. The above condition is responsible for the trouble reported in district No. 4.

### Tracks in Very Bad Shape.

Return feeders, besides the one stated above, are also used (see drawing No. 2), they are bonded to the tracks at different points of the system, but they are of comparatively small section and little current can be carried by them. To sum up it will suffice to say:

1. With the exception of Main Street from the Assiniboine River to the C.P.R. subway, Portage Avenue from Main Street to Hargrave Street, Notre Dame Avenue from Main Street to Charlotte, Corydon Avenue from Pembina Street to Lilac Street, Lilac Street from Corydon Avenue to Woodlaw Avenue and the tracks which are being now bonded with electrically brazed bonds (i.e. Dufferin Avenue and Logan Avenue) the track returns of the Winnipeg Street Railway Company are in very bad shape.

2. The load on the Mill Street substation and its location are such that it is not possible to return through the rails and return feeders only, the large volume of current required for the street railway service.

Electrolytic troubles and damage to the piping system and cables result from these two conditions and is spread out over the whole of the centre of the city, although it has appeared only, so far, in certain districts.

### Recommendations.

The cure for the electrolytic trouble should come from the Electric Railway Company as the city cannot do anything to protect its piping system from stray currents.

Remedial means are mainly those which I have already stated in my preliminary report dated April 1, 1909, and addressed to your secretary, namely:

1. Installation of substations at different points of the system—this with a view of diminishing the amount of current to be returned through the rails in the centre of the city.

2. Proper rebonding of all tracks that show defect.

3. Special bonding and cross bonding work at intersections.

4. A system of inspection of track returns by the railway company.

A substation system of power distribution will do away with the electrolytic trouble. At present the whole current for the railway service being fed from one station, gives rise to a concentration of current in the tracks situated in the heart of the city. The current density in the rail returns must be kept low. The soil in this city shows a very low resistance and only very small difference of potential in rail returns can be allowed. This must be assisted by a rebonding of the tracks which show defects, that is, which indicates excessive drop. All bonds showing a reading of more than 4.5, that is, whose resistance is greater than 4.5 feet of rail should receive attention and be made good. Track intersections should also receive careful attention, ground plates at sides of bridges to carry return currents from one side of river bank to the other must be done away with and insulated feeders placed instead.

### Action By Company.

I am pleased to state that the Winnipeg Electric Railway Company is carrying its work along these lines. Following recommendations made by William B. Boyd, chief engineer, Toronto Railway Company and Toronto Power Company, Toronto, and approved by the writer, the Winnipeg Railway Company have placed orders for electrical machinery, which will be installed in three new substations located as follows: One substation near the car barns at Fort Rouge, another on the line running to the Country Club, approximately 17,000 feet from the Mill Street substation, and the third in the north end of the city near the car barns. This will reduce very largely the amount of current returning through the rails on Main Street. These rails are now very much overloaded with current.

In connection with the rebonding of the tracks, the railway company have now in the city, and in operation, a bonding car for electrically brazing copper bonds on the rail joints. This type of bond, carefully installed, will secure an effective system of rail return. It can be easily applied on old work with very little disturbance of pavements. Tests made on Logan Avenue, where this type of bond is in place, show very low readings of voltage drop. The work being carried out now by the railway company on Dufferin Avenue shows construction work of a very substantial nature and plans for special work at intersections submitted by the railway company to your city electrician and approved by the writer will give intersections with very small drop of potential.

Besides the above, the railway company have advised me through Mr. Boyd, that it is the intention of the company to carry out the following work of reconstruction of their tracks:

1. New rails on Broadway from Main Street to Osborne Street.

2. New rails on River Avenue from Main Street to Osborne Street.

3. New rails on Osborne from Assiniboine River to Spadina Avenue.

4. New rails on Academy Road from Wellington Crescent to Stafford Street.

5. New rails on Notre Dame Avenue from Nena to Arlington Avenue.

The Winnipeg Railway Company must be instructed to proceed with this rebonding work and with the installation of the substations without delay. The rebonding of the tracks must proceed at maximum speed, night and day, until the whole system is in proper condition. After this is done, all bonding of the rails to the telephone cables and pipes should be removed, as well as the ground plates at bridges. The amount of copper in the feeder returns from Main Street, corner of Portage Avenue, to the substation, must be increased to at least 10,000,000 c.m. and the railway company should be instructed to place these wires in the ground in approved conduit.

The writer also desires to recommend that following the termination of the work above outlined, that is, sometime in the fall, a survey be made to see results accomplished.

The third recommendation made, namely, that the railway company should maintain its plant in a high state of efficiency through a rigid inspection of the track returns, is of the greatest importance to the city and should be enforced. The track returns should be under test at all times, in order to remedy at once any faulty bonds as they appear.

Accurate records of the drop of potential at different points of the railway system should be kept by the railway company and be open to inspection of the city electrician.

If the above recommendations are carried out with a desire to obtain best results, troubles due to electrolysis will be practically eliminated. In conclusion, the writer desires to acknowledge his indebtedness to Mr. Boyd for his assistance in this investigation.

The electrolysis tests were carried out by Mr. Beaubien, electrical engineer, Montreal, assisted by Mr. McGinnis, of the Winnipeg electrical department. Respectfully submitted.

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The reconstruction of the Antung-Mukden Railway ordered by Japan will require two and a half years and cost $15,00,000.

## COMPRESSED AIR ENGINEERING.*

By Frank Richards.

The employment of compressed air as the agency of power transmission on some of the Barge canal contracts, suggests inquiry as to the advantages and disadvantages of such transmission. Of course, in a way, contractors use their own experience and judgment, and select, and determine their own means and methods, the only ultimate consideration being as to the perfect execution of the work and the complete satisfying of the specifications, but, still, if the means adopted find general approval from the start, the satisfying progress and the winning finish may be more confidently predicted.

The great engineering works of the ancients, and even those of the moderns up to a century ago, were executed, so far as we know, almost entirely by human hands using the primitive tools. To-day if the pick, shovel and the wheelbarrow, backed by the main strength of the laborer, are ever permitted upon works of any extent, the fact calls at once for explanation or apology.

With the advent of machinery as modernly employed, steam was almost universally adopted as the source of power, and subject to the limitation of partially developed mechanical practice, it was applied as directly as possible to the machines to be operated or to the work to be done. For all outdoor engineering work the pumps, the hoists, the pile drivers, the excavators, the rock breakers, the means of haulage and what not, were all directly, and usually individually, steam driven, and apparently no one asked for, or indeed thought of, any radical change or improvement in motive power for such work or in the system of its distribution.

It has always been practically impossible, however, to use steam in mining, in tunnel driving or in subaqueous work of any kind, and practice in these lines developed and improved slowly in conseqence. The rock drill it was which first demanded the air compressor, and the earlier builders of air compressors in large, commercial units found all their business provided for them by rock drills, and quite naturally to-day the largest builders of air compressors are also the principal rock drill makers.

This initial and compulsory employment of compressed air for rock drills in mines and tunnels, and similar work, developed rapidly, compressors became numerous, and practical men began to appreciate the ready applicability of air to the various uses hitherto monopolized by steam. It happens that practically all the apparatus which is operated by air is similar to, if not identical with, that which is steam driven, and all steam driven machines can be driven and generally better driven by compressed air. Where a supply of compressed air has necessarily been provided for the strictly underground machines, and where there have been outdoor machines as part of the same general plant, it has often been a simple matter to pipe the air to the latter also, and thus to have the one power system to cover the entire series of associated mechanisms. Wherever this has been done compressed air has shown itself not only permissible but extremely desirable and profitable, even for the additional items of employment not strictly compulsory.

As to the better drive of air than steam for the same machinery, that is easily demonstrable. Rock drills, whether to be operated by air or steam, are practically identical in design and construction, the only difference being usually in the style of stuffing box used. All drills are run for a considerable time at the factory, to get them broken in and running smoothly and satisfactorily before they are sent out. All the steam drills are first worked with air and after they work all right with that, then steam is used, and it invariably requires long and tedious coaxing before the drills can be made to run as freely and as lively with steam as they did with air. The first admission of the steam causes unequal heating and expansion of the closely fitted members, and also the condensed steam chokes the small and tortuous passages about the valves; also the lubricant which is used, when once it wets the surfaces of the air operated tool, remains a long time, while when steam is used in a drill for only a few minutes, so that it is thoroughly heated if the drill is taken apart and the surfaces supposed to have been lubricated examined, no trace of oil will be found in them, and they will usually be reported "as dry as a bone." The favorable experience with the rock drill, as to the use of air in preference to steam as the operating fluid, is repeated with all other styles of normally steam driven machines. The air operated machine is always and instantly ready and only the throttle requires to be manipulated or thought of.

In driving the tunnels of the Pennsylvania railroad under the Hudson River at New York, it is not conceivable how the work could have been done without the constant aid of compressed air; but for the enormous excavation required for the passenger station of the same company, which was all outdoor work, the use of compressed air was not imperative, but still air was adopted for the work entirely upon its merits by men who knew, and the results have fully proved the wisdom of the choice.

The similar and even more extensive work of excavation for the new station of the New York Central in the heart of New York City, this also entirely outdoor work, is similarly being done entirely with compressed air as the power transmitter.

For engineering works of large extent and the completion of which will require months or years, so as to make the installation of a suitable plant worth while, compressed air is becoming more and more the favorite, where formerly only steam would have been thought of. Some of the largest stone quarries which have promise of permanence of output are now operated entirely from central air compressing plants. The compressed air installations on the Barge Canal at Crescent, at Vischer's Ferry and on the contracts in the western sections are fully warranted by successful engineering experience.

As has happened before in engineering matters and in other things having to do with the world's progress, it has not been the scientific investigators, the official testers of efficiencies, those whose function it is to explain the why of things, who have been the leaders and promoters in this extension of general outdoor compressed air practice. For appreciation and opportunity compressed air is indebted almost entirely to the practical men who have been most closely in touch with it, and now the theorists can pat them on the back and patronizingly assure them that "they builded better than they knew." Perhaps so.

It is by no means difficult, after the practical man has established the practice, to find many cogent reasons which justify the extensive and permanent employment of compressed air. The general impression has been that, while compressed air has many things to recommend it in practice, it is still very wasteful of power, or that the amount of power ultimately realized at the extremities of the piping systems where the air is used is but a small fraction of that which is consumed in the initial compression of the air. The power losses in the use of compressed air have been harped upon until some persons have been able to think of nothing else in connection with it.

The truth is really in the other direction, when the use of air is compared with that of steam for the lines of work we are here considering. It is quite possible to show that the use air compressed by steam at a central station, instead of using steam direct in the individual, widely distributed machines, effects a distinct saving at the coal pile and an enormous saving of operative labor in addition, besides securing the many accompanying minor advantages not generally enumerated and often not even thought of.

Of course, it is an easy thing to cite cases showing how power is wasted by the employment of compressed air for power transmission. Some such occurred early in the compressed air experience of the writer himself. For nearly my first lesson, there was a straight-line, single-stage air compressor running at normal speed and the entire air out-

* From the Barge Canal Bulletin.

put of it was used to drive a steam pump down in a coal mine, the length of piping being not more than 1,000 feet, and the greatest efficiency I was able to figure out in the case, starting with the indicator card of the steam cylinder of the compressor, was 19 per cent. Of course, some of the loss here shown was chargeable to the pump itself, with its large clearance spaces to fill, and the use of the air entirely without expansion. Many cases where the too familiar steam pump is driven by compressed air would show results worse than this, while other types of apparatus so operated might show up somewhat better.

In another case I had a straight-line, single-stage compressor, with piping not exceeding 300 feet, to a small flywheel governor, slide-valve steam engine of suitable size. It was possible to adjust the work of the engine—the work was the driving of a fan—and the speed of the compressor so that the one would just supply the other, and each could be brought to a constant running speed. In this case the air passed through a heater by which its temperature was raised 150 degrees Fahr., and its volume correspondingly increased before it entered the engine. The best efficiency I could figure out in this case was 37 per cent.

All who have to do with compressed air can cite instances of power losses such as this, and they would seem to be conclusive against the use of the air, so far as power economy is concerned, were it not for the fact that a decidedly worse case can be made out against the use of steam. In the case where numerous machines are distributed over considerable areas, where the machines are all of them operated intermittently and with constantly varying loads, it is obviously impossible to make tests of power consumption for record or comparison. It is possible, however, to come to some agreement as to probable performance. A hoisting engine may be assumed to be as good an example as any of the machines to be driven. It will probably be fair to assume that the hoisting engine driven by air and working under fair ordinary conditions will, when actually working, realize 25 per cent. of the power consumed in compressing the air. That is, if a horse-power at the compressor costs four pounds of coal per horse-power hour, the coal cost at the hoisting engine will be sixteen pounds per horse-power hour. One important thing in connection with each employment of compressed air is that it costs practically nothing except for the work actually done by it, and only while the work is being done. There are no heat losses and the losses by leakage which we speak of later, are practically negligible. To cover all imaginable losses, however, we may concede an additional 5 per cent., thus allowing the net horse-power realized in work actually done by the compressed air driven machine to be only 20 per cent. of the initial horse-power at the steam driven compressor, and making the coal cost per horse-power hour, therefore, five times as great as at the compressor, or 20 pounds per horse-power hour.

As a matter of record it is quite possible to operate central compressor plants, with compound steam cylinders and condensers, and with boilers and boiler accessories designed and operated for economy, with less than three pounds of coal per horse-power hour. Then five times this, as above, would be only fifteen pounds as the coal cost at the air driven machine.

When water can be utilized as the source of power, with or without the employment of electricity for transmission, the cost which then takes the place of the coal cost must be usually much less, or the water-power would not be employed, and this means that the cost which takes the place of the coal cost at the air driven machine is also less than it would be if steam was employed to drive the compressor, or it would be less than the equivalent of fifteen pounds of coal per horse-power hour.

It is concededly impossible to generate steam at a central station and to transmit it by piping to the several machines to be operated, as we do transmit the air, on account of the constant heat radiation of the line and the consequent losses of condensation, besides the trouble caused by expansion and contraction of piping, water-hammer, etc., the necessity of providing arrangements for trapping or disposing of the water of condensation, and, in spite of all precautions, the frequent stoppage for repairs entailed Each steam operated machine, therefore, must have its own boiler and all appurtenances, its own supply of fuel and water. Such isolated and intermittently operated machines, taking the day through, cost in coal actually consumed at least thirty pounds, and often much more, per horse-power hour of work actually done, or about twice as much as the coal cost of the air operated machine.

With the air driven machine, when the air is piped to it, that ends it, and the operator has only to manipulate the throttle and attend to the lubrication. With the steam driven machine there is not only the cost of the coal actually consumed, but there is also, the bringing of the coal to the machine, the supplying of the water, the firing and caring for the boiler, with all which that implies, so that there is for each machine the labor of a man, or at least the equivalent of one man's labor, to be added to the cost of operating.

The equivalent in coal cost of a man's labor is worth considerable. Say that coal costs at the machine $4 per short ton. Then if the man's wage is $2 per day, that will be 1,000 pounds of coal, or 100 pounds per hour, and for ten horse-power, which is a big allowance for a hoisting engine, this would be ten additional pounds of coal cost per horse-power hour.

So far, then, as the actual cost of the power used is concerned there is evidently a great saving in the employment of air instead of steam, and on this account alone it is no wonder that the knowing ones choose the air transmission, even when there are no special conditions, as in mining, tunneling, subaqueous work, etc., compelling them to do so.

In addition to the saving in coal cost there are other advantages which air carries with it. In the use of steam there is the time taken to fire up and get the pressure before work commences, there is the warming-up process and the working of the water out of the pipes and cylinders every time the machine is started up after standing, none of which delays occur with the air, so that in constant readiness and instant realization of power to the utmost limit required, the air will every day put in from 10 to 25 per cent. more actual work per day. Stuffing boxes will give no trouble; water will not knock out cylinder heads; pipe joints will not be giving out; there will be no chance of low water in the boiler, no burning of flues or crown sheet, no possible blow up. The cost and repairs of maintenance will be much less and the certainty of continuous readiness for work will be much greater. While, as was said, the air-driven machines are identical with the steam-driven type, the individual boilers and all their appurtenances are dispensed with, the cost of them, so far as it goes, helping to offset the larger cost of the compressed air installation as a whole. The saving in repairs and maintenance, with the reduction in the cost of the air-operated machines by dispensing with their boilers, may go to offset the fixed charges entailed in the larger cost of the compressors and piping.

(To Be Continued.)

## OBITUARY.

MR. SAMUEL ROTHWELL, master mechanic of the B. W. and N. W. Railway died at Brockville, August 14th, aged fifty-two. Deceased was a native of St. Catharines, Ont., but spent most of his life in Brockville. Prior to going with the B., W. & N. W. railway he received his training on the G.T.R. and C.P.R., being engaged on the Rocky Mountain construction of the latter line.

MR. EARNEST ALLEN, B.Ss., formerly Ontario representative for the Buffalo Forge Company, has accepted a position as salesman for the Allis-Chalmers-Bullock Company. No territory has been assigned to him as yet. Mr. Allen is a Bachelor of Science of Harvard's technical school, of the class of 1908

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Aug. 11 | | STOCK QUOTATIONS — TORONTO | | | | STOCK QUOTATIONS — MONTREAL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Aug. 13 '08 | Price Aug. 5 '09 | Price Aug. 12 '09 | Sales Week End'd Aug12 | Price Aug 12 '08 | Price Aug. 6 09 | Price Aug. 13 '09 | Sales Week End'd Aug13 | |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,586,000 | 1,420,000 | 172 171 | 186½ 186 | 188 187¼ | 331 | 172½ 172¼ | 187 186¼ | 187⅞ 187¼ | 3300 | |
| Canadian Northern Railway | 2,986.9 | | | 183,200 | 167,600 | | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 832,475 | 794,562 | | | *1st. pref. 105½, 3rd pref. 56¾, ordinary 24¼ | | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | 30,420 | 18,053 | | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 77,932 | 73,261 | | | | | 181 180⅜ | 215 214 | 215½ 214½ | | |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,999 | 66,917 | 106½ | 126 | 126¾ 126 | 270 | 106⅞ 106 | 125⅞ 125½ | 126 125½ | 571 | |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 162 161 | 187½ 187 | | 6 | 163½ 162 | 187½ 187 | | 6 | |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILROAD EARNINGS.

Total gross earnings of all United States roads reporting for the first week of August amount to $2,334,133, a gain of 12.5 per cent. over the same week last year, and of 0.8 per cent. over the record year, 1907. Railroad earnings steadily increase, and the immense volume of traffic is gratifying testimony of the near return to normal conditions. In the following table is given earnings of United States roads so far reporting for the first week of August, and the same roads for July; also the more complete reports for July and the two preceding months:—

| | Gross earnings 1909. | Gain. | Per cent. |
|---|---|---|---|
| August (one week) | $ 2,334,133 | $ 259,545 | 12.5 |
| July (one week) | 2,051,179 | 216,464 | 11.8 |
| July | 37,247,812 | 2,274,893 | 6.5 |
| June | 39,317,205 | 3,438,960 | 11.1 |
| May | 38,660,233 | 4,761,111 | 9.6 |

A number of United States roads have now reported for July, total gross earnings of which amount to $37,247,812, a gain of 6.5 per cent. over the same week last year, but a loss in comparison with 1907 of 14.0 per cent. All classes of roads contribute to the increase in the comparison with last year, the gains being most notable in other Eastern, Granger and South-western roads. The statement is printed below:—

| June. | Gross earnings 1909. | Gain. | Per cent. |
|---|---|---|---|
| Trunk, western | $ 5,707,005 | $ 308,914 | 5.7 |
| Other Eastern | 823,510 | 150,881 | 22.3 |
| Central Western | 6,264,183 | 294,905 | 4.9 |
| Granger | 1,711,950 | 133,151 | 8.4 |
| Southern | 13,324,467 | 586,344 | 4.8 |
| Southwestern | 9,416,697 | 800,698 | 9.3 |
| U. S. roads | $37,247,812 | $2,274,893 | 6.5 |
| Canadian | 7,004,000 | 808,000 | 6.5 |
| Mexican | 4,422,621 | 209,000 | 4.9 |
| Total | $48,673,433 | $3,291,893 | 7.0 |

## CALGARY STREET RAILWAY FOR JULY.

| | |
|---|---|
| Earnings | $5,392.77 |
| Expenses | 1,397.41 |
| Profit | $3,995.36 |

## TORONTO AND NORTHERN ONTARIO FOR FIRST HALF YEAR.

Temiskaming and Northern Ontario Railway earnings continue to mount upward. The report for June shows a remarkably good state of affairs. The gross revenue from operation for the month was $131,850. The expenses were $73,648, leaving a net revenue from operation of $58,202. The amount received from ore royalties was $19,273, making the total net receipts $77,475, as compared with $30,573 for June 1908. For the six months ended June 30, the net revenue from operation was $309,174, and from ore royalties $68,355, making a total of $377,529, compared with $55,103 for the same period last year.

## TORONTO STREET RAILWAY.

The Toronto Street Railway Company continues to thrive. The company's receipts in July totalled $239,819.59, this being $28,368.07 in excess of the receipts in July 1908. Figures for the month of July, back to 1904 follow:—

| | |
|---|---|
| July 1909 | $329,819.59 |
| July 1908 | 301,451.52 |
| July 1907 | 305,645.50 |
| July 1906 | 271,217.40 |
| July 1905 | 242,698.60 |
| July 1904 | 213,854.20 |

## NOTE.

The gross earnings of all United States roads reporting for the first week of August amount to $2,334,133, a gain of 12.5 per cent. over the same week last year and of 0.8 per cent. over the record year 1907. Railroad earnings steadily increase and the immense volume of traffic is gratifying testimony of the near return to normal conditions.

## CURRENT NEWS.

TORONTO.—The Armbrust Canadian Brake Shoe Company of Toronto will have an exhibit in the Machinery Hall of the Canadian National Exhibition, consisting of the Armbrust Steel Back Brake Shoes for engines and cars, also Steel Brake Beams and Roller Bearings for freight and passenger cars, and other Railway specialties.

TORONTO.—On September 3rd and 4th a special meeting of the Canadian Forestry Association will be held at Regina, Sask., when subjects having special reference to the prairie Provinces of Canada will be taken up, such as tree-planting on the eastern and western sections of the prairies, forest reserves, game protection, growing wood for fuel and for windbreaks, the relation of forests to the conservation of moisture, etc. The meeting will be opened by His Honor Lieutenant-Governor A. E. Forget. The secretary, James Lawlor, 11 Queen's Park, Toronto, invites all who intend going to communicate with him.

**Catalogues Wanted.**—Messrs. Smith, Kerry & Chace, consulting engineers, of Toronto and Winnipeg, who have recently opened offices at 68 McDougall Block, Calgary, in order to deal more conveniently with their increasing business in that section of the West, would be glad to receive catalogues of electrical and engineering supplies at that address.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWER GASES AND DISEASE INFECTION.

We publish in this issue the results of experiments and conclusions by Prof. C. E. A. Winslow, being an examination of the possibilities of disease infection being carried by means of sewer air.

Generally speaking, bacteriologists are extremely skeptical as to the theory that zymotic disease germs leave the body of running sewage, are transmitted to the supernatant air and are carried by that air either up and through vent-pipes or by plumbing defects into buildings.

Certainly all the experiments made in this connection go to prove that the danger of bacterial infection from drain air is but slight. Lately, however, Major W. H. Horrocks, of the English Army Medical Corps, has reported a series of experiments on sewer air to the Royal Society at London. These experiments point to the conclusion that where splashing occurs, bacteria may be thrown into the atmosphere and carried by a current of air. In the natural conditions which exist, however, in a drainage system Professor Winslow demonstrates that the danger of infection from this source is even less than that from drinking the water supplied to New York citizens, which invariably shows the presence of B. coli in ten cubic centimetres.

The conclusions, which we publish, will be read with interest by sanitarians, and apart from the possibility of the direct transmission of sewer bacteria to air, we would call attention to the final paragraph, noting the general possibility of gases from decomposing matter having a predisposing influence upon the body, which may cause it more easily to succumb to specific germs.

The general knowledge that epidemics are not directly traceable to sewer air emanations has brought about a more crucial examination of the role played by flies in carrying infection from exposed sewage collections and the ultimate destiny of the sewage with reference to its possible contact with food supply, especially with regard to water and milk.

**Note.**—The articles appearing in this Review entitled "Sewage Disposal," the first part of which has already been published under the heading "Removing of Solids," the second portion being headed "Removal of Putrescibility," are specially prepared for this Journal by Mr. T. Aird Murray, C.E. We make this announcement as portions of the articles have been reproduced in several technical papers without any recognition of the same. The author reserves the right to publish the articles in book form.

## SEWAGE DISPOSAL—REMOVAL OF PUTRESCIBILITY.

### CHAPTER III.

### Land Intermittent Filtration.

"There can be no doubt that, where the soil is suitable and the area of land sufficient, the organic matters in sewage can be thoroughly oxidised by land treatment." (See fifth Report of the Royal Commission on Sewage Disposal, par 192, page 137.)

The truth of the above announcement must certainly be admitted; it remains simply a question of suitability of the land and quantity available. The knowledge that sewage properly applied to land will give high purification results is by no means new. We have a capital example of efficient land intermittent filtration in Canada at Berlin, Ont. Here much difficulty was at first experienced in solving the problem of sewage disposal. The sewage of Berlin is exceptionally strong, and rendered complex in character by a large proportion of trade waste effluents. Before any definite scheme was decided upon, several experiments were made with reference to both contact and percolating biological treatment under the auspices of the Ontario Provincial Board of Health. Although several of the experiments gave fair results, considering the characteristic strength of the sewage and the nature and quality of the experiments made, there being a large area of sandy land in the neighborhood, land intermittent filtration was finally resolved upon, preceded, of course, by preliminary removal of solids in settling tanks. These works have continued to give splendid results, and prove conclusively that, with a climate such as exists in South Ontario, land intermittent filtration is a satisfactory method, granted the suitable character and amount of available land.

Before discussing the nature of the non-putrescible effluent rendered by land intermittent filtration and comparing the method and its results with those of artificial biological filtration, it will be well to examine generally what really constitutes a suitable character of land, as well as the area required.

There is no doubt but that efficiency is directly proportionate to porosity, given a sufficient depth of porous soil. Peat land being practically non-porous, is useless, while strong clay is equally so, while the best results are to be obtained by a land consisting almost totally of sand as at Berlin (Ont.) The British Royal Commission publish the result of systematic observations and investigations of land treatment at a large number of so-called sewage farms. The Commission obtained the best results at Nottingham (Eng.), where the soil is a light sand loam and gravel overlying gravel and sand. Here over 10,000 gallons per day per acre are treated, the percentage chemical purification representing a removal of putrescibility of 99 per cent., calculated on oxygen absorbed from permanganate at 26.7° C. (80° F.) in four hours. At South Norwood, where the land consisted of clay soil resting on London clay, only 4,000 gallons per acre per day were treated, and a purification on the above basis of only 81 per cent. was obtained as against 99 per cent. at Nottingham.

The fact that the amount of purification is relative to the character of the soil, led the Massachusetts Board of Health, in the first instance to make the valuable experiments referred to in the last chapter, and prove just what may be done with the soil in that State in the case of land intermittent filtration.

There is no doubt that one of the chief reasons for the generally acknowledged failure of land sewage treatment exists in the past tendency to bring into use any sort of land independent of its suitability. The result of this tendency is extremely unfortunate, and is responsible for a prevailing conceit that artificial biological filtration is in every case superior to land treatment. It is very necessary that this

idea shall not prevail in Canada, where land may at times be obtained at very low rates, and where it is often of a very suitable character, especially in the sand districts of South Ontario. It must be remembered that natural sand land presents a biological filter "in situ," and only because of the fineness of the grains and consequent degree of porosity being less than the coarser materials of an artificial filter, it consequently requires a larger area to deal with the volume of liquid accompanying the sewage.

Referring again to the Laurence experiments, especially with reference to soil examinations, the method adopted of arriving at the size of the particles constituting the bulk is of interest. The soil is first dried, and then passed through sieves of the following meshes: 10, 5, 2, 1, 0.5, 0.25, and 0.1 mm. Five grammes of the finest of the above samples are mixed in a glass tube containing 200 c.c. of distilled water, being thoroughly mixed by forcing air through the tube. After fifteen seconds of settlement, the supernatent liquid is drawn off, the sediment representing particles 0.1 to 0.05 mm. The liquid undergoes a similar mixing process, and is allowed further settlement for thirty seconds. the particles precipitating being regarded 0.05 to 0.03 mm. The process is again repeated with sixty seconds' settlement, leaving a sediment varying from 0.03 to 0.01 mm. Any remaining sediment is regarded as organic matter. All the samples are dried at 105° C. until constant in weight. This method presents eleven portions or sizes. The total weight of the portions is equal to the weight of the dried soil originally taken, less a slight loss due to the process.

An examination of the material used in Filter No. 6 gave the following sizes:—

| | | | | | |
|---|---|---|---|---|---|
| Size in m m., less than..... | 12.6 | 6.2 | 2.2 | 0.98 | 0.46 |
| Per cent. ..... | 83 | 73 | 57 | 32 | 13 |
| Size in m m., less than.... | 0.24 | 0.12 | 0.06 | 0.03 | 0.01 |
| Per cent. ..... | 7 | 4 | 2 | 0.05 | 0 |

The effective size of the material constituting the above filter will be found between the sizes 0.46 and 0.24, viz., 0.35 representing the 10 per cent. curve below which the remaining sizes are smaller than 0.35. The uniformity coefficient works out at 7.8, representing the 60 per cent. curve divided by the effective size. Very coarse soil may give a uniformity coefficient as ten or more, and a very fine soil two or less. The best soil for land intermittent filtration is to be found with an effective size of 0.3 mm. and a uniformity coefficient between two and five. The latter more nearly represents the material used in the Laurence Filter No. 4.

The materials composing soils may be separated with reference to the diameters of the particles as follows:—

| | mm. | | mm. |
|---|---|---|---|
| Grits of fine gravel with diameter..... | 2.0 | down to | 1.0 |
| Coarse sand with diameter ..... | 1.0 | " | 0.5 |
| Medium sand with diameter..... | 0.5 | " | 0.25 |
| Fine sand with diameter..... | 0.25 | " | 0.10 |
| Very fine sand or dust with diameter... | .10 | " | 0.05 |
| Silt with diameter ..... | 0.01 | " | 0.005 |
| Clay with diameter ..... | 0.005 | " | 0.0001 |

Given the effective size and uniformity coefficient of a soil, a deductive examination and comparison with the above diameters will give an approximate idea of the character of the soil in question. For example, in the case of the Lawrence Filter No. 5, the effective size of which was 0.02 mm. and the uniformity coefficient 9.0, it is not difficult to arrive at the conclusion that the material was composed of fine river silt mixed with coarser material, the effective size, .02, being quite unsuitable, causing the spaces between the coarser material to become clogged

The water-retaining capacity of a soil is of great importance in land intermittent filtration. In this relation the remark previously made "that efficiency is directly proportionate to porosity," requires qualifying. If a quantity of soil be first dried, and then dosed with water, it is only capable of holding up or retaining so much of the water, the balance percolating through the soil. The volume of water capable of being retained after the excess has been allowed to thoroughly drain away is equal to the water-retaining capacity. Soils which are suitable for filtration as far as their effective sizes and coefficient values are concerned present a water-retaining capacity of from 16 to 18 per cent. of the volume occupied by the soil.

If the effective size is too large, the water-retaining capacity is too small, and sufficient time is not allowed for absorption of the organic matters, the latter passing away into the under-drains unoxidized. On the other hand, if the effective size is too low, as in the case of Lawrence Filter No. 5, the water-retaining capacity is too great, resulting in clogging and flooding of the surface with a cessation of oxidation.

The results of the Lawrence experiments, and, in fact, all experiments, prove that the volume of sewage applied either to land or to percolating biological filters at a single dose should in no case exceed the water-retaining capacity. This, theoretically, means that every dose of sewage pushes downward the retained previous dose, taking its place, and remaining, during the intermittence of time, in contact with the soil, during which period organic matter in solution is absorbed. The following works of land intermittent filtration have been installed in the State of Massachusetts as the result of the Lawrence experiments:—

| Name of town. | Population. | Date at which works were introduced. |
|---|---|---|
| Framingham ..... | 7,000 | 1888 |
| Andover ..... | 6,813 | 1893-94 |
| Clinton ..... | 13,667 | 1898-99 |
| Concord ..... | 5,652 | 1898-99 |
| Gardner ..... | 10,813 | 1891 |
| Leicester ..... | 3,416 | 1894 |
| Marlborough ..... | 13,609 | 1890-91 |
| Nalick ..... | 9,488 | 1895-06 |
| Pittsfield ..... | 21,766 | 1890 |
| Westborough ..... | 5,406 | 1891-92 |
| Worcester ..... | 118,421 | 1890 |

The Framingham sewage works have been in work for twenty years, and others for almost similar periods. Framingham in 1903 discharged an average of 542,000 gallons of sewage per day, including trade waste effluents, representing 33,000 gallons from color works and 15,000 gallons from a hat factory. The sewage is first treated in a collecting chamber of a capacity equal to 350,000 gallons for the removal of solids. The land occupied is about 100 acres in extent, but only about twenty acres have been brought into use for intermittent filtration, this being divided into eighteen plots or filters. The soil is of a coarse, gravelly character. Eleven of the eighteen plots are underdrained at a depth of six feet. The effluent from the undrained filters shows itself by springs along the river banks. Throughout the year the amount of sewage treated is equal to about 0.03 cubic yard per square yard of area. The rate of filtration per acre is about 27,000 gallons per acre per day. The beds are ploughed each year and planted with maize. When cutting the maize in autumn six inches of stalk is allowed to remain, which tends to support the ice in winter, the filtration going on under the ice.

The sewage reached the works from January to May, 1903, at a temperature of 7.2° C., rising in June to 8.9°, and reaching a maximum of 15.5° in August. The average analysis of both the raw sewage and effluents are here given for 1903:—

We may judge of the purification shown by the above analysis by considering the effluent from the eastern drain; the other effluents show higher purifications. With the former we have a 92.6 per cent. as regards free ammonia, 97.1 per cent. albuminoid ammonia, and 63.2 per cent. in the oxygen absorbed. Even during the coldest months the percentage absorbed in the oxygen absorbed is 90.9.

It cost $10,500, including drainage, to level and prepare the surface of the twenty acres. The total cost was:—

| | |
|---|---|
| Collecting chamber (capacity, 358,500 gallons and rising main) | $40,775 00 |
| Pumping station | 15,650 00 |
| Pumps (capacity, 1,665,400 gallons per day) | 6,925 00 |
| Purchase of land (100 acres) | 6,625 00 |
| Construction of filters (twenty acres) | 10,550 00 |
| Total | $80,525 00 |

The maintenance is very small, as laborers are only employed part time. The maize crops realize $85 per annum profit. The working expenses at the pumping station amount to $4,250 per annum.

The splendid results obtained at Framingham, and, in fact, at the works generally in Massachusetts, are due to the excellent work done by the State Board of Health, which does not only examine the plans for proposed schemes, but supervises the construction of the works and inspects the working capabilities from time to time.

Unfortunately in Canada our Provincial Boards of Health have not powers equal to the State Boards of Health on the other side. In fact, as far as being effective machines in controlling municipal health engineering problems, up to the present they have been a mere farce.

The Royal Commission have to state, par. 195, page 143, Fifth Report: "Generally speaking, the evidence points to a maximum rate of 30,000 gallons per acre, or 1,000 persons per acre (this at the rate of thirty gallons per head per day) with the best land after preliminary treatment, although some witnesses put the rate as high as 60,000 gallons per acre. With unsuitable land, such as clay, not more than 3,000 gallons per acre can be efficiently treated, even after settlement of solids.

It will be noted that the volume treated at Framingham, Mass., is 27,000 gallons per acre per day, and at Nottingham, England, 10,700 gallons, and at each place good results were obtained. The present writer's experience with land intermittent filtration, which is considerable, is that with the best of land 30,000 gallons should never be exceeded. At Brockton, Mass., where an average of 731,060 gallons of sewage is successfully treated by land intermittent filtration, twenty-two acres of land is utilized. This gives a rate of 22,000 gallons per acre per day. The land is divided into twenty-three filter beds, and the average daily quantity of sewage dealt with by a single filter was 23,540 gallons. On the average they received a dose of sewage every third day, some as many as 168 doses a year, and the average volume

CHEMICAL ANALYSIS OF FRAMINGHAM CRUDE SEWAGE

(Yearly Average of Monthly Analyses.)

(Parts per 100,000)

| TOTAL SOLIDS | | SOLIDS IN SOLUTION | | SOLIDS IN SUSPENSION | | AMMONIA (N.H.3) | | | | CHLORIDES | OXYGEN ABSORBED | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ALBUMINOID | | | | | |
| TOTAL | LOSS ON IGNITION | TOTAL | LOSS ON IGNITION | TOTAL | LOSS ON IGNITION | FREE | TOTAL | IN SOLUTION | IN SUSPENSION | | TOTAL | IN SOLUTION |
| 58.77 | 29.88 | 37.53 | 13.66 | 21.24 | 16.22 | 17 | 0.79 | 0.41 | 0.38 | 6.99 | 4.67 | 2.69 |

CHEMICAL ANALYSIS OF EFFLUENTS FROM FRAMINGHAM SEWAGE

(Yearly average of Monthly Analyses)

(Parts in 100,000)

| | TOTAL SOLIDS | AMMONIA (N.H.3) | | CHLORIDES (Cl) | NITROGEN | | OXYGEN ABSORBED | IRON |
|---|---|---|---|---|---|---|---|---|
| | | Free | Albuminoid | | Nitric | Nitrous | | |
| Eastern Drain | 29.15 | 0.236 | 0.023 | 5.32 | 1.002 | 0.017 | 0.31 | 0.044 |
| Western Drain | 27.87 | 0.198 | 0.015 | 5.03 | 0.969 | 0.013 | 0.21 | 0.028 |
| Spring | 21.06 | 0.0004 | 0.002 | 3.81 | 0.910 | nil | 0.04 | 0.005 |

The results of the Massachusetts efforts told in words make land intermittent filtration appear to be a very simple process. An intermittent filter must be treated, however, like a living thing. If it is overfed, its digestion is interfered with. The equilibrium between absorption and oxidation must be maintained. A filter will become accustomed to a certain dose, and even to a certain character of sewage. Data affecting the highest possible efficiency in each case must be obtained and the filters worked accordingly.

With reference to the question of the area of land required, of course this must depend entirely upon the character of sewage as well as upon the character of the land. Within certain limits the strength of a sewage, independent of the volume treated, affects the efficiency of artificial biological filters. This, however, is not so in the case of land. Land consisting of fine grain material is incapable of dealing with comparatively large volumes of liquid apart entirely from the work to be performed in oxidizing the sewage matter.

of sewage per dose was 70,000 to 90,000 gallons. Sometimes as much as 130,000 gallons was discharged to a filter at one time, and the maximum volume so discharged was 222,000 gallons. One filter received 440,000 gallons on one occasion. It is probable that on no occasion should any one filter have received a dose of over 200,000 gallons at one time, as we see that each filter was under an acre in area.

Assuming a sand soil with an effective size (0.3 mm.) and a uniformity coefficient of five, the underdrainage being placed six feet deep, each square yard of land would then represent 54 cubic feet of filtering material. Sixteen per cent. of this, or about eight cubic feet, would represent the water-retaining capacity. Such a soil at an acre in area per filter should, therefore, never receive above 240,000 gallons at a single dose. In the case of Brockton, the average purification for the year 1903 was by the oxygen absorbed test 98.5 per cent.

(To be continued.)

## BACTERIA IN SEWER AIR.

Prof. C. E. A. Winslow.*

The idea of the connection between sewer gas and disease dates back to the days when the cause of the infectious maladies was still unknown. Mysterious miasmatic influences were naturally enough supposed to accompany the foul odours of decomposing organic matter. When it was proved that the contagious and infectious diseases are due to the presence of microscopic plant and animal parasites, the case against sewer gas seemed less convincing.

Nageli and many other bacteriologists showed that under ordinary conditions germs adhere strongly to moist surfaces, and are not easily given off from liquids into the adjacent air. Sir Edward Frankland in England, and Raphael Pumpelly in this country carried out experiments which indicated that chemicals in solution, and bacteria in suspension, might be thrown into the air from liquids by the bursting of bubbles. On this contingency the possible danger of sewer gas infection still might rest.

Actual examinations of the air in sewers, however, by Miquel in France, Petri in Germany, and Carnelley, and Haldane, Robertson and Laws and Andrewes in England, showed that sewer air as a mattter of fact contains very small numbers of bacteria, and those of types common in street air rather than in sewage. Uffelmann found the same condition in the air of a house drainage system. Carnelley and Haldane, and Laws and Andrewes isolated sewage bacteria in the immediate vicinity of points where active splashing occurred. As in the experimental studies of Frankland, Pumpelly and Dr. Abbott, of Philadelphia, there was clearly a possibility of air infection where spray was produced by some mechanical method. On the whole, however, the air of drains and sewers seemed to be of high bacterial purity, and all the observers who studied normal conditions in actual sewers concluded that the danger of bacterial infection from sewer air was remote.

These results, with the absence of any reliable evidence from the study of epidemics in favor of the transmission of germs by sewer air, has led sanitarians in Germany and the United States to agree with practical unanimity that the danger of such transmission may be disregarded. In England, on the other hand, a large number, probably a majority, of sanitary experts have failed to be convinced, and have clung to the opinion that under some conditions the carriage of disease bacteria by sewer air is a practical possibility.

A little over a year ago, at the request of the National Association of Master Plumbers, I made some experiments on this problem, upon which no practical investigations had been conducted for over ten years. I used an experimental stack of 4-in. soil pipe, 15 feet, in height, with a running trap at the bottom and an exhaust fan, for drawing up a strong current of air, at the top. Sewage was placed in the trap, sealing it partially or completely, or resting in the bottom without sealing it. Air was drawn over the sewage and wetted surfaces of the pipe, or was bubbled through the sealed trap, and the air was examined at various points in the stack above. When the air current was strong, an increase was noted in the bacterial content of the pipe air; but the increase was not striking even at high velocities, and was entirely wanting with air currents of less extreme force. Only three of the characteristic bacteria of sewage were isolated from the air in the whole series of experiments. As a result of this investigation I reported that the danger of bacterial infection from drain air was but slight.

At about the same time a series of experiments on sewer air was reported to the Royal Society of London by Major W. H. Horrocks, of the English Army Medical Corps. His results seemed at first sight to warrant widely different conclusions from those drawn by other observers; and it seemed necessary to re-examine the whole question with the greatest care.

Major Horrocks's general method consisted in the artificial infection of the lower part of natural and experimental drainage system with a peculiar bacterium, the Bacillus prodigiosus, which is not normally found in the air. He then exposed small open dishes of nutritive media (Petri plates) in the upper part of the systems. Germs carried up in the air fell on the plates grew and developed into visible colonies, and among these colonies he identified the particular form, Bacillus prodigiosus, introduced in the liquid at the bottom. By this process he detected his test organism in a pipe 9 feet above an experimental running trap into which it had been introduced, and in the air of a catch basin of the town into which he had poured it. Similar results were obtained when the lower sections of his experimental pipe system were wetted with a culture of the Bacillus prodigiosus and then dried. The dried germs were apparently detached, carried up by the air and deposited on the plates. In another series of experiments sewage infected with typhoid bacillus, or with Bacillus prodigiosus, was allowed to flow, quietly and without splashing, through a horizontal pipe to which a vertical pipe was connected at an intermediate point. Plates exposed in the vertical pipe showed colonies of the specific bacteria introduced below, even at a height of 11 feet 9 inches, above the liquid. Again, emulsions of Bacillus prodigiosus were flushed from the closets of drainage systems in actual use, and germs thus introduced were found in all parts of the systems in open connection therewith, even at a height of 50 feet above the traps. Major Horrocks, by the same method of exposing Petri plates, found Bacillus coli, the characteristic organism of sewage, in a house drain and in the main sewer of the town. Finally he passed the feces of a typhoid patient suspended in water through a half-S trap, and found the typhoid organism on plates in a vertical pipe above it at a height of 3 feet 6 inches above the liquid.

Major Horrocks's report, and still more recent series of confirmatory experiments by Dr. F. W. Andrewes of London naturally excited the deepest interest among sanitarians. In many quarters the old suspicions of sewer air were revived in almost their full force.

The Journal of the American Medical Association, for example, said in commenting upon Horrocks's work: "We may still have to look to sewer emanations as the occasional cause of mysterious outbreaks of disease." The other sanitarians maintained a more conservative attitude, and waited further evidence before abandoning their previous conclusions. The matter stood about as follows: On the one hand, Horrocks had shown that specific bacteria, present in traps and drains, could get into the air above by splashing, by the bursting of bubbles, and even in some experiments from the surface of liquids apparently in quiet motion; he detected such bacteria by the plate method in the air of ventilating pipes at considerable distances (once at 50 feet.) above the infected liquid. On the other hand, Miquel, Petri, Uffelmann, Carnelley and Haldane, Laws and Andrewes, and others, had shown that the number of bacteria actually present in the air of sewers and house drains is extremely small, and that those present are generally air forms and not sewage forms. Furthermore, reliable evidence of the spread of infectious disease by sewer air is wholly lacking. In the inconsistency of the two sorts of evidence required in explanation; and, after presenting the facts to the Sanitary Committee of the National Association of Master Plumbers, I was commissioned by them to attempt the clearing up of the apparent contradiction.

I first attempted to repeat as closely as possible one of Horrocks's simpler experiments. I examined the air of a boat chamber on one of the main sewers of the city of Boston, as Horrocks had done in the sewers of Gibraltar. I found colon bacilli, the characteristic sewage organism,

*Of the Massachusetts Institute of Technology to the National Association of Master Plumbers of the United States.

on my plates in many experiments; but their number was least nearest the sewage, greater nearer the street, and greatest in the street air itself. It was clear that they came from street dust infected by horse dung, etc., and not from the sewage at all. I then constructed an experimental pipe system, such as Horrocks used, consisting of a half-S trap of 6-inch tile drain, to which an 8-foot vertical stack of the same pipe was connected. A rich emulsion of Bacillus coli culture, in soapy water was poured through the trap and Petri dishes of nutrient gelatin or agar were suspended at various points in the pipe above. Control plates were also exposed at various points in the laboratory outside. Six out of twenty-eight plates exposed in the pipe over the Bacillus coli emulsion showed colonies of this germ, fourteen colonies in all. Eight out of the twenty-four plates exposed in the pipe over the liquid infected with Bacillus prodigiosus showed this organism, seventeen colonies in all. The general effect of these experiments was, therefore, to confirm the results of Major Horrocks. My tests, like his, showed that specific bacteria are discharged into the air from the surface of foaming infected liquids, and may be carried up in connecting pipes for considerable distances. Furthermore, I found that the velocity of an air current capable of transporting bacteria in the form in which they are sprayed into the air from an atomizer is very low indeed.

Granting, then, that infection of the air above sewage may take place, how can the results of actual examinations of sewer air be explained? The idea suggested itself at once that the whole question might be a quantitative one. It might be possible that under extreme conditions sewage bacteria get into the air, but that the number discharged is so small under normal conditions that it does not appreciably affect the composition of the air of the sewer as a whole.

I next, therefore, attempted to investigate the question from this stand point and made first a careful examination of the best available quantitative methods. Horrocks's procedure of exposing open dishes of nutrient media to the air is, of course, not quantitative at all, since the bacteria which happen to fall on the plate are not related to any particular volume of air. The method adopted by most recent observers, and the one which I used in experiments reported a year ago, involves the straining out of the bacteria in a measured volume of air by drawing it through a sand filter. The bacteria are then washed out from the sand in sterile water and enumerated by the ordinary cultivation methods. During my work this year I developed a new method in which a measured volume of air is drawn into two large culture bottles, and the bacteria are allowed to settle out and form colonies of nutrient media in the bottom of the bottles. This method, although cumbrous, avoids all danger of losing bacteria by drawing them through the sand, and was used in all my latter work. A careful series of comparative tests, showed, however, that the sand method used in other investigations is essentially accurate, and earlier results may be accepted as correct in their general conclusions.

By the use of the culture bottle method I next attempted to control Major Horrocks's results from the quantitative standpoint. I prepared a rich emulsion of Bacillus prodigiosus, containing hundreds of millions of bacteria per litre, made it foam freely by beating it up with soap, and poured into a large glass bottle, or into anopen dish. The air in the bottle, or the air of the laboratory over the open dish, was examined by the culture bottle method. Out of thirty litres of air examined, five only contained Bacillus prodigiosus. In one litre three were found, and in the other four one each. Clearly the bacterial infection of the air produced by very vigorous foaming was but slight.

In these experiments there was but little splashing of the infected liquids; the bursting of bubbles from the foaming surface was the only source of air infection. I next imitated natural conditions more closely. Through the kindness of Mr. Craig I had an ordinary porcelain water-closet bowl set directly on a 4-inch cast-iron S trap, having a clean-out hole at its crown. The S trap was connected at its lower end with an ordinary 4-inch running trap. A rich soapy emulsion of Bacillus prodigiosus was poured rapidly into the water closet bowl, so as to rush down through the two traps, foaming and splashing as it went. Samples of air were collected from the clean out at the crown of the upper trap, and from the upper opening of the lower running trap, a few inches only from the foaming surface of the liquid. Everything was as favorable as possible for the discharge of bacteria into the air. Yet, out of forty-four litres of air examined, forty-three contained no Bacillus prodigiosus. One litre showed a group of eleven colonies apparently derived from a single infected droplet. It must be remembered that in these experiments I used liquids artificially infected with large numbers of specific bacteria, and caused foaming artificially by heating them up with a considerable addition of soap. Vigorous splashing was added to foaming in the last series of tests. Under these extreme conditions, as in Major Horrocks's experiments, the specific bacteria present could be detected in the air; yet the actual number present even here was extremely small.

These experiments seemed to offer a reasonable explanation of the difference between Major Horrocks's rsults and those of other observers. Bacterial infection of the air from foaming liquids may take place. Horrocks, using for the part artificially prepared emulsions and ignoring the quantitative aspect of the case, naturally obtained positive results. When the question is approached numerically, however, the amount of air infection, even under extreme conditions, is so slight that one would scarcely expect the general air of sewers and house drains to be appreciably affected under normal conditions.

The final test of experimental conclusions of this sort must always be made by an appeal to existing conditions under normal circumstances of actual use. The numerous investigations cited above have shown that the air of street sewers is indeed singularly free from bacteria. The air of house drainage systems might, however, be supposed to be worse than that of the street sewer; and with regard to their bacterial condition only the single report of Uffelmann appears to be available. As a crucial test, I therefore determined to carry out a sufficient number of examinations of house drain air to gain a fair idea of its bacterial composition. With the cordial co-operation of Mr. Craig, I have been able to complete this work and to obtain results which seem to be conclusive.

I studied nineteen different plumbing systems, five in buildings of the Massachusetts Institute of Technology, four in the wards of the Boston City Hospital, three in a block of East Boston tenements, two at the Boston City Hall, two at the Hotel Lenox, and one each in the Ames Building, in the Technology Club, and in a private residence on Newbury Street. The plumbing pipes were tapped at various representative points, on the main stack in the lower part of the building, on the projection of the main stack above the roof, on clean outs on the main house drain, or wastes from fixtures and dead ends in connection with the house drain, and in one case on the stack. From each of twenty points selected, ten litres of air were drawn off and examined for the characteristic bacteria of sewage, the colon bacillus and the sewage streptococcus.

In all, 200 litre samples of air were examined. Three samples were lost from the fact that the liquid sewage in the plumbing pipe ran into the collecting tube and over into the culture bottle, directly contaminating it with liquid. There remained then, 197 tests. Of these 193 showed no sewage bacteria present. In the remaining four cases, sewage organisms were found, the colon bacillus three times, and the streptococcus once. In each one of these four cases there was a discharge of sewage in the pipe at the point of examination, and at the moment the sample was taken, so that spray was actually splashing in the air. In each of the four cases a sample of air from the same point

ten minutes later showed no sewage forms present. In not a single case out of the 200 were sewage bacteria present in a litre of house drain air, unless there was mechanical splashing at the point, and at the moment of examination.

In general my results confirm the results of Horrocks, in so far as they show that specific bacteria may be ejected from liquids into the air above. My tests of house drain air, like those of Carnelley and Haldane and Laws and Andrewes on sewer air, indicate that mechanical splashing may produce a local infection of the air in immediate contact with the spray. Such an infection does not, however, extend for any distance or persist for more than a minute or so. I found the general air of house drainage systems singularly free from bacterial life. Out of 200 litres examined, only forty-eight contained any organisms capable of development at 37 degrees. Sewage bacteria were found in the air of the house drains only four times out of 200 litres, and then in the presence of mechanical spraying of sewage at the point of collection. The general air of the house drainage system, aside from this local infection, was, as far as examined, free from sewage organisms. These results accord well with those obtained by Miquel, Petri, Carnelley and Haldane and Laws and Andrewes in street sewers, and with those reported by Uffelmann for drain air.

The experiments of Major Horrocks, rightly interpreted, in no way contradict this general concensus of opinion. He demonstrated a possibility by using, for the most part, artificially infected and foaming emulsions, and by ignoring all quantitative considerations. We must deal, however, in sanitation, not with theoretical possibilities, but with probabilities, measured as closely as possible in regard to their practical importance. I have found in my experiments that even under the most extreme conditions the number of bacteria which get into the air from an infected liquid is small. I have found by the examination of a series of plumbing systems in actual use that intestinal bacteria could only be isolated four times out of 200 litres, and then only at points of direct local infection from splashing.

In a surface water of good quality, like that of New York City, the colon bacillus can almost invariably be isolated from 10 cubic centimetres. This means a slight degree of intestinal pollution, but experience has shown that the chance of infection from such a water is but slight; and we drink it without serious alarm. If one were to breathe for twenty-four hours the undiluted air of a house drainage system, at any point not immediately infected by mechanical splashing, it appears that less than fifty intestinal bacteria would be taken in, for the daily consumption of air is about 10,000 litres, and in 200 litres I obtained negative results from air of this sort. In drinking New York water, twice as many colon bacilli are ingested every day, for 1,000 cubic centimetres is a small amount for daily consumption. So there would be less danger of contracting disease from continually breathing the air of a vent pipe, or a soil pipe, except where liquid is actually splashing, than from drinking New York water.

There is a possibility, of course, that the gaseous emanations from decomposing organic matter may exert a predisposing organic influence which makes the body succumb more easily to specific germs, introduced in other ways. Many have held that in this way sewer gas might indirectly promote disease. This view, supported mainly by the experiments of Alessi, well deserves further study, but I have not dealt with it in the present investigation. I believe, however, that my results in the light of all previous evidence, warrant the conclusion that the chance of direct bacterial infection through the air of drains and sewers is so slight as to be practically negligible.

H. Walters & Sons, of Hull, are formed into a joint stock company to manufacture axes and tools. The incorporators are J. E. Gravelle, of Hull; J. G. Walters, N. P. Walters, James Walters, H. J. Thomas, of Ottawa, and the capital stock is $350,000.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7645—July 27—Authorizing the Brantford Gas Company to lay and maintain a three-inch gas main under the track of the Toronto-Hamilton and Buffalo Railway at Oak Street, Brantford.

7646—July 23—Directing C.P.R. to forthwith erect, maintain and operate station at the village of Wattsburg, B.C., known and described as its Standard No. 6 station.

7647—July 27—Approving basis of Standard Passenger Tariff of the Quebec Railway, Light and Power Company, C.R.C. No. 8, 2½c. per mile.

7648—July 26—Authorizing the City of Toronto to lay and maintain water pipe under tracks of G.T.R. at Royce Avenue, Toronto.

7649—July 26—Authorizing the City of Toronto to lay and maintain a water pipe under the tracks of the C.P.R. at Royce Avenue, Toronto.

7650—July 27—Authorizing the Pere Marquette Railway Company to remove the east derail at Walkerville Junction, Ont., to a point 495 feet from the crossing.

7651—July 27—Approving plan and profile of proposed crossing of the municipality of Johnston, Tarbutt, and Tarbutt additional over the Soo branch at or near mile post 148 between Lots 4 and 5, Concession 6, Township of Johnston.

7652—July 27—Extending until December 1st, 1909, the time fixed by Order of the Board 6804 dated April 6th, 1909, for the installation of the interlocking plant of the C.P.R. at Drumbo, Ont.

7653—July 26—Refusing application of the City of Toronto for leave to construct additional bridge across the tracks of the C.P.R. and G.T.R. at Dundas Street.

7654—July 26—Authorizing the C.P.R. to construct, maintain and operate two branch lines of spurs into the premises of R. Gordon, Arcola, Sask.

7655—July 22—Reopening for consideration at the first sitting of the Board in Hamilton or Brantford, Ont., the application of the Toronto, Hamilton and Buffalo Railway, for Order to renew, reconstruct or alter the highway bridge under which the railway crosses the public highway in the Township of Brantford, at a point about three miles east of Brantford, Ont.

7656—July 27—Approving location of Canadinan Northern Railway through Townships 10-9, Ranges 30-32, West Principal Meridian, Province of Saskatchewan, mileage 0 to 16.09.

7657—July 24—Approving Canadian Northern Quebec Railway Tariff of Sleeping and Parlor Car Rates, C.R.C. No. S.I.

7658—July 24—Approving Canadian Northern Ontario Railway Standard Tariff of Maximum Parlor Car Tolls, C.R.C. S. 4.

7659—July 24—Approving C.P.R. Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7660—July 24—Approving Canadian Northern Railway Standard Tariff of Berth and Seat Rates, C.R.C. No. S.I.

7661—July 24—Approving Michigan Central Railway Company Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7662—July 24—Approving the Wabash Railroad Company's Tariff of Parlor Car Fares, C.R.C. No. S. 2.

7663—July 24—Approving Toronto, Hamilton and Buffalo Railway Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7664—July 24—Approving Rutland Railroad Company Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7665—July 24—Approving the Esquimalt & Nanaimo Railway Company Tariff of Parlor Car Rates, C.R.C. No. S.I.

(Continued on Page 210.)

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### CONCRETE SEWER.*

The main sewer on Princess Street, Hamilton, Ont., from Sherman Avenue to Wentworth Street, is 24 inches diameter, and it was proposed to build this with fire clay pipe. All the other main sewers, being of larger diameter, were built of concrete. Before finally deciding on fire clay pipe in that section, 100 feet of 24-inch sewer was laid, composed of concrete, mixed 1:2:4, four inches thick, two-thirds of the sewer being constructed in the trench, the upper one-third was moulded on the surface and placed in the sewer after being properly set. The cost of this section of sewer was carefully kept in detail, with the result that the concrete sewer was found to be much cheaper than the fire clay pipe. Therefore, it was decided to construct a concrete sewer in this section.

**Cost of 24-inch Diameter Concrete Sewer—Labor and Materials—100 Lineal Feet.**

**Labor.**

| | |
|---|---|
| Bottom, 2:3, 9 men 9 hours at 20c | $16 20 |
| Bottom, 2:3, setting moulds, 3 men 9 hours at 20c | 6 21 |
| Top, 1:3, moulding, 2 men 18 hours at 20c | 7 20 |
| Setting tops | 10 00 |

**Material.**

| | |
|---|---|
| 70 bags cement | $35 00 |
| 5 loads gravel (10 cubic yards) | 10 80 |
| Coal for mixer | 1 00 |
| Total cost for 100 feet | $86 41 |

Cost per lineal foot of concrete pipe sewer 24-inch diameter, 86 4-10c.

### LOCAL COSTS OF PIPE-LAYING IN NEW ENGLAND.

In their recent investigation of the Boston Water Department, Metcalf & Eddy, consulting civil engineers for the Boston Finance Commission, collected considerable comparative information regarding the cost of pipe-laying in various cities in New England. These costs were all on the day labor basis by municipal forces. The difference in dimensions of the trenches and in wages and hours of labor made comparison somewhat difficult, but the engineers succeeded in reducing to practically a uniform basis, and in adjusting the rates at different periods so as to conform to the period covered by the cost determination in Boston. This includes 2½ years, namely 1905 to July 1st, 1907. From Metcalf & Eddy's report, which has recently appeared in a volume of some 1,200 pages the following digest has been made:

In the accompanying table are given, following the name of each city, the wages and hours of common labor during the period under discussion; the length of pipe included in making up the average cost; the years in which this pipe was laid; the actual labor cost per foot; the depth of trench; the corresponding cost per foot for a trench six feet deep, such as is used in the City of Boston; and, finally, the corresponding cost for a six-foot trench, if the wages had been uniformly $2 per day and the hours sixty per week.

In making the computations, it was assumed that a trench six feet deep would cost 20 per cent. more per foot than one five feet deep. As a matter of fact the actual increase in cost would probably be something less than 20 per cent., since there would be very little if any increased cost of placing the pipe, making joints, etc., and no increase in the cost of teaming. On the other hand, the cost of excavation for the lowest foot might be a little greater than one-fifth of the average cost, but in most cases probably not enough greater to offset the practically unchanged cost of the items mentioned above. The addition of 20 per cent. is, therefore, probably more than ample to allow for the increased depth of trench.

In reducing the actual costs to what they would have been had the wages been $2 per day and the hours sixty per week, it has been assumed that the actual efficiency of labor per hour was unaffected by the change in hours and wages.

The figures in the last column of the table should be absolutely comparable. The greater difficulties encountered in Boston on account of many obstructions, etc., do not enter, since all jobs involving such difficulties have been rigidly excluded from the computations and comparisons.

From them it is evident that the pipe-laying cost in the City of Boston is 69 per cent. greater than that of the average of the other seven cities, and nearly 44 per cent. greater than the cost in Worcester, where it is the highest of any of the seven.

In the case of Cambridge, besides data showing the cost in 1905, average labor cost per foot was furnished of laying 4, 6, 8 and 12-inch pipe from 1894 to 1903. The fluctuations in these costs are not remarkable, and there was no wide divergence from the average during this period of ten years. After adding 20 per cent. to make the figures comparable with those for six-foot trench in Boston, the average for the ten years was 40.4 cents per foot for all sizes, or, separating the figures, 31.4 cents for four-inch pipe, 35.1 cents for six-inch, 43.4 cents for eight-inch and 51.6 cents for twelve-inch. In 1905, however, as already noted, the average cost on the comparative basis was 60.3 cents per foot, an increase of 49 per cent. over the average for the ten years 1894-1903. No data were furnished which explained the sudden increase.

Reducing 40.4 cents per foot to the $2 per day and sixty hour per week basis, the comparative labor cost of pipe-laying in Cambridge prior to 1904 was found to be 31.6 cents per foot. During this same period, 1894-1903, the labor cost in Boston reduced to the same basis was rapidly increasing, and ranged from 37.3 cents at the beginning of the period to 59.3 cents at the end, or from 18 per cent. to 88 per cent. more than the cost in Cambridge.

Metcalf & Eddy show that from the foregoing information it can only be concluded that under labor conditions as they exist in other neighbouring cities, a fair average labor cost for pipe-laying work, reduced to the uniform basis of $2 per day and sixty hours per week, would be about 42 cents per foot, with 50 cents as a maximum. Of course individual pieces of work would often exceed the average and others would frequently fall considerably below it. As against these fair costs, this work cost the City of Boston, on the same basis of hours and wages, about 70 cents per foot for the three years prior to July 1907, or from 40 to 70 per cent. in excess of its reasonable cost.

Reduced to the basis of hours and wages, at the time of the report (i.e., forty-four hours per week and $2.25 per day), the fair average labour cost as estimated upon the basis of a cost in other cities would be 63.7 cents per foot, with 76.6 cents as a reasonable maximum, against which the average cost for the previous two and one-half years (on the same basis) was equivalent to $1.081 per foot, an excess of 44.2 cents per foot, or 69 per cent. over the fair average cost.

It is difficult to estimate the total excess cost resulting from this inefficiency of labor. The lengths of pipe laid from which the average costs were computed—including only those jobs on which there were no special difficulties which

* From information furnished by A. F. Macallum, C.E., City Engineer, Hamilton, Ont.

might render them not comparable with other jobs, and including no rock excavation—constitute but a small part of the total pipe of these sizes (6 inches to 12 inches) actually laid. It is probable that on the jobs involving special difficulties, where the actual labor costs must have been greater, the excess over a reasonable cost was also larger; and on contract jobs, which have usually been done at a less cost than the day labor jobs, the excess over a reasonable cost would be less. The total length of six-inch to twelve-inch pipe laid in the year 1906-07, as stated in the last annual report of the Boston Water Department, was 57,949 feet. If the excess labor cost on all of this may properly be taken as 44.2 cents per foot on the $2.25 per day basis, equivalent to 39.2 cents on the $2 per day basis, then the city actually paid $22,000 more than it should have done, for labor alone, in laying pipe of six-inch to twelve-inch diameter in 1907.

The total length of main pipes laid in the year 1906-07 was 71,307 feet. Since the inefficiency labor is not confined to work upon small sizes of pipe, and is experienced in some degree upon the contract work as well as upon that done by day labor, the engineers estimate that this inefficiency resulted in a total excess cost of pipe-laying, for labor alone, amounting to something like $20,000, and possibly much more, for the year ending January 31, 1907.

TABLE SHOWING COMPARATIVE LABOR COST OF LAYING PIPE IN VARIOUS CITIES.

| City. | Actual Average Wages—Hours of Wages. | Common Labor. Hours. | Length of Pipe Included in Computing Average Cost, | Year. | Actual Cost of Labor per Ft. of Pipe, | Depth of Trench, | Computed Cost of Labor per Foot of Pipe for 6-ft. Trench, | Corresponding Cost of Labor per Foot of Pipe with Wages $2, and Hours 60 per Week —Trench 6 Ft. Deep. |
|---|---|---|---|---|---|---|---|---|
| | | | Feet. | 1905-06-07. | Cents. | Feet. | Cents. | Cents. |
| Boston | $2.00 | 44 | 12,151 | (To July 1). | 96.1 | 6 | 96.1 | 70.5 |
| Worcester* | 2.00 | 48 | 5,551 | 1907 | 50.9 | 5 | 61.1 | 48.9 |
| Cambridge | 2.00 | 47 | ..... | 1905 | 50.25 | 5 | 60.3 | 47.3 |
| Lowell | 2.00 | 48 | 5,915 | 1907 | 49.1 | 5 | 58.9 | 47.1 |
| Somerville | 2.00 | 47 | 2,418 | 1906 | 45.2 | 5 | 54.2 | 42.5 |
| Newton | 1.75 | 48 | 2,238 | 1906-07 | 53.0 | 6 | 53.0 | 42.4 |
| New Bedford | 2.00 | 48 | 15,720 | 1907 | 34.7 | 5 | 41.6 | 33.3 |
| Chelsea | 2.00 | 46 | 2,474 | 1906 | 32.7 | 5 | 39.3 | 30.1 |
| Average of all except Boston.. | 2.00 | | | | | | | 41.7 |

*It should be noted that a portion of the work done in Worcester in 1907 showed extremely high costs, and the average cost is therefore high. Had the year 1906 been taken the average cost in last column would have been 34.7c.

## RAILROAD ORDERS.

(Continued from Page 208.)

7666—July 24—Approving the Great Northern Railway Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7667—July 24—Approving G.T.R. tariff of Pullman Company's Berth and Seat Rates, C.R.C. S. 977.

7668—July 24—Approving G.T.R. Tariff of Parlor Car Tolls, C.R.C. No. E. 940.

7669—July 24—Approving Quebec Railway, Light and Power Company Parlor or Chair Tariff, C.R.C. No. S.I., between Quebec and St. Anne.

7670—July 24—Approving Central Vermont Railway Company Tariff of Pullman Company's Berth and Seat Rates, C.R.C. No. 233.

7671 — July 26—Authorizing the Vancouver and Lulu Island Railway Company to construct its railway across Granville Street, in municipality of Point Grey, B.C., such authority to be in force only for a period of three months from date of Order pending a further hearing by the Board in the City of Vancouver.

7672—July 23—Approving of plans for the superstructure of the bridge carrying the tracks of the Dominion Atlantic Railway Company across the Sissiboo River at Weymouth, N.S.

7673—July 29—Directing the Great Northern Railway Company to forthwith provide station accommodation at the old stopping places adjoining the spur constructed into the mill at Hazelmere, B.C.

7674—July 23—Extending until September 7, 1909, the time in which the G.T.R. and Bay of Quinte Railway Company shall establish and maintain a through joint rate on bituminous coal to Marlbank, Ont.

7675—August 3 — Authorizing the Canadian Northern Quebec Railway Company to construct a bridge to replace the wooden structure near Stonefield Station, Que.

7676—August 3—Authorizing the C.P.R. to open for the carriage of traffic that portion of the second track of the Ignac Section of its line of railway, from mileage 119.8 to mileage 120.0, a distance of 0.2 miles.

7677—July 30—Authorizing the C.P.R. to open for carriage of traffic the portion of its Ignac Section from mileage 115.1 to 120.8 Fort William Section, being portion of the double track.

7678—July 30—Authorizing the Bethesda and Stouffville Telephone Company to install its telephone instruments in the stations of the G.T.R. Company at Stouffville and Unionville, Ont.

7679—July 30—Approving plan of the New Brunswick Southern Railway Company for construction of a bridge at West Waweig, N.B.

7680—July 30—Approving detail plan of the subway at Winnipeg Street in the village of Schreiber, Ont., to be built by the C.P.R.

7681—July 30—Approving plans of the proposed bridge of the Canadian Northern Quebec Railway over Blanche River near Montcalm Station.

7682—August 3 — Authorizing the Canadian Northern Quebec Railway Company to construct its railway across public road between Lot 213 and Lot 147, Parish of St. Severin, mileage 71.44 west from the Quebec Bridge.

7683—July 16—Authorizing the Canadian Northern Quebec Railway Company to construct its railway across the public road between Lot 345 and Lot 344, 344-a, and 346 in the Parish of St. Prosper, at mileage 62.23 west from Quebec Bridge.

7684—July 16—Also across public road between Lot 336 and Lots 331, 332, 334, and 335, in the Parish of St. Prosper, mileage 61.0 west from the Quebec Bridge.

7685—July 16—Also across the public road between Lot 324 and Lots 317 and 318 in the Parish of St. Prosper at mileage 60.11.

7686—July 16—Also across public road between Lot 429 and Lots 430 and 432 in the Parish of St. Prosper.

7687—August 3—Authorizing the Canadian Northern Quebec Railway Company to construct its line across the public road on the north-east side of Lots 9 and 10 south-west of St. Severin Station, mileage 73.77 west from Quebec Bridge.

7688—August 3—Also across the public road on the north-east side of Lot 130 E., south-west of St. Severin Station, County of Champlain, Que., mileage 73.51 west from the Quebec Bridge.

7689—July 29—Authorizing the Canadian Northern Quebec Railway Company to open for the carriage of traffic the portions of its line from its connection with the Quebec and Lake St. John Railway at Quebec, to Garneau Junction, Quebec, a distance of 78.76 miles.

7690—August 3—Approving revised location of the Chemin de Fer de Colonization du Nord being about mileage 15 north-westerly to about mileage 20 north-westerly (from Nomining).

7691—July 16—Authorizing the Montreal Terminal Railway Company to construct, maintain and operate branch line on premises of the Lakefield Cement Company at Longue Point, Que.

7692—August 3—Authorizing the Bolton Telephone Company to carry its wires across the tracks of the C.P.R. at Lot 8, between Concessions 1 and 2, Township of Albion, Ont.

7693—August 4—Authorizing the Municipal Council of Maidstone, Ont., to carry wires across track of G.T.R. at Tecumseh Road, Puce Street.

7694—August 3—Authorizing the Oro Telephone Company to carry its wires across the tracks of the G.T.R. on Colbourne Street, in the Township of Oro, Ont.

7695—August 3—Authorizing the Fingal Telephone Company to carry its wires across the track of the Pere Marquette Railroad at public crossing three miles west of St. Thomas, in Southwold Township, Ont.

7696—August 3—Authorizing the Oro Telephone Company to carry its wires across the track of the G.T.R., where the same crosses the road allowance between Concessions 3 and 4 in the Township of Oro, Ont., north of the Ridge Road.

7697—August 3—Authorizing the Municipal Council of the Maidstone to carry its wires across the tracks of the C.P.R. at the road east of the Puce River public crossing, about three miles west of Bell River Station, Ont.

7698—August 3—Authorizing the C.P.R. to construct, maintain and operate spur to the premises of the Wood McNab Lumber Co., on the British Columbian Southern Railway, East Kootenay District, B.C.

7699—August 3—Authorizing the G.T.R. to construct five bridges between Chatham and Windsor, Ont., on the 18th District.

7700—August 3—Authorizing the Atlantic, Quebec and Western Railway Company to construct bridge at Grand River Crossing, Section 6, mileage 51.

7701—August 3—Authorizing the C.P.R. to construct branch line to premises of the Ontario Lime Association, on the north side of Dupont Street, Toronto.

7702—August 3—Authorizing the Canadian Northern Ontario Railway Company to construct bridge over the Vermillion River at mileage 26.66 from Sudbury Junction, Ont.

7703—August 5—Temporarily approving pending the final determination by the Board of the tariffs of tolls which the Bell Telephone Company shall be authorized to charge, its agreements with six rural telephone companies.

7704—August 3—Authorizing the C.P.R. to construct bridge No. 77.7 on the Moose Jaw Section, Western Division.

7705—August 3—Authorizing the C.P.R. to construct bridge No. 9.4, North Branch Michael Creek, Cranbrook Section.

7706—August 3—Authorizing the G.T.R. to construct branch line commencing at the G.T.R. station yard of the Town of Oakville, Ont., thence north-easterly and crossing the Seventh Line Road to the north side of the said road.

7707—August 5—Authorizing the Hamilton Cataract Power, Light & Traction Company to carry its power wires across the tracks of the Toronto, Hamilton & Buffalo Railway in the Township of Ancaster, at Horning Mountain Road.

7708—August 5—Recommending to the Governor-in-Council for sanction the by-law of the Canadian Northern Quebec Railway re spitting and smoking in cars and on premises.

7709—August 5—Recommending to the Governor-in-Council for sanction lease of the C.P.R. with the St. Mary's and Western Ontario Railway, dated February 1909.

7710—August 5—Recommending to the Governor-in-Council for sanction by-law of the Canadian Northern Ontario Railway re spitting and smoking in cars on premises.

7711—August 5—Approving location of the Canadian Northern Railway through Section 4, Township 22, Range 17, west of 6th Meridian to a point five miles beyond the Railway Belt, mileage 10 to 24.

7712—August 4—Approving location and detail plans of C.P.R. Station at Indian Head, Sask.

7713—August 5—Extending until October 1st, 1909, the time for the installation of gates at the crossings of the C.P.R. at Vancouver, B.C., at Columbia Avenue.

7714—July 15—Authorizing the Corporation of the City of Fort William to cross with the lines of its Electric Street Railway, together with the necessary poles and wires and to transmit power over the tracks of the C.P.R. at the intersection of the line with Pacific Avenue, Fort William, Ont.

7715—August 5—Directing the Commissioners of the Transcontinental Railway to provide an interlocking plant at the crossing of the Temiscouata Railway near Grand Falls, N.B., and authorizing the operation of trains at the crossing for construction purposes only pending the installation of the interlocking system.

7716—August 5—Approving book of reference of the United Gold Fields of British Columbia, Ltd., showing amended location of line from Frank to Grassy Mountain, B.C.

7717—August 5—Approving book of reference of the Esquimalt & Nanaimo Railway, showing change in location of line from mileage 100 to 107 and mileage 107 to 127.

7718—August 5—Approving location of the Georgian Bay and Seaboard Railway from mileage 48.05 to 63.42 from a point opposite Lot 17, Concession 1, in the Township of Eldon, on the County Boundary to point in Lot 23, Concession 12, Township of Mariposa, County of Victoria, Ont.

7719—August 5—Approving of revised location of Georgian Bay and Seaboard Railway from mileage 41.95 to 48.05, being from point in the north half of Lot 10, Concession 2, Township of Mara, to a point on the County Line east of south half of Lot 1, Concession 8, Township of Thorah, County of Ontario.

7720—July 28—Approving "exceptions" to the rating of silver ore to the official classifications as incorporated in the G.T.R. freight tariffs C.R.C. Nos. E-1599 and 1600 and C.P.R. freight tariffs, C.R.C. Nos. E-1422 and 1450, applying from North Bay, Ont., to certain points in the United States.

7721—August 3—Authorizing the Municipal Council of Maidstone, Ont., to carry wires across the tracks of the C.P.R. at public crossing about three miles west of Belle River Station.

7722—July 30—Authorizing the City of Brandon, Man., to carry water main under tracks of the C.P.R. and Great Northern Railway Companies on Twenty-Sixth Street.

7723—August 3—Authorizing the Bell Telephone Company to carry wires across the tracks of the C.P.R. and at public crossing, North St., Perth, Ont. 7724—At public crossing Wilson St., Perth Ont. 7725—At public highway crossing on the Cyrville Road, Ottawa, Ont., just east of the Rideau River.

7726—August 3—Authorizing the Bell Telephone to carry its wires across the tracks of the C.P.R about 800 feet east of Sturgeon Falls, Ont. (Nipissing Street).

7727—August 3—Authorizing the Bell Telephone Company to carry its wires across the tracks of the C.P.R. about 1,300 feet west of Mile Post 21 (on road allowance between the Townships of Springer and Pedley); 7728—across public highway crossing about 750 feet east of mileage 63 (west of Massey, Ont.).

7729—Authorizing the Bell Telephone Company to carry its wires across the tracks of the Central Vermont Railway Company at Lake Street, Waterloo, Que.

7730-3—Authorizing the Bell Telephone Company to carry its wires across the tracks of the C.P.R. 300 feet west of Sturgeon Falls, Ont. (King Street). 7731—At public crossing about 300 feet west of mileage 61 (west of Massey, Ont.).

7732—July 31—Authorizing the Caradoc and Ekfrid Telephone Company to carry its wires across the tracks of the C.P.R. on the town line between Caradoc and Ekfrid.

7733—August 5—Authorizing the Bell Telephone Company to carry its wires across the tracks of the C.P.R at Daniel Street, Arnprior, Ont.

## HYDRO-ELECTRIC DEVELOPMENT.

### Colorado Yule Marble Co.*

By S. S. Stone, B.S.

In the northern part of Gunnison county, Colorado, its snow-capped peaks towering 13,000 feet above sea-level, stands White House Mountain. On its steep and oft-times precipitous slope are vast deposits of marble; literally a mountain of snow-white marble. Here are the quarries of the Colorado Yule Marble Co., 9,000 feet above the level of the sea.

Volumes might be written of the hardships endured and dangers incurred in opening these quaries; of the beauty and grandeur of the rugged scenery thereabouts. After leaving the hot springs of Glenwood, one of the beautiful little health resorts of Colorado, the train takes us through canons, along precipices, following the sparkling Crystal River, now on one side, now on the other, but always climbing, till, when we arrive at our destination, we discover that in the forty miles between Glenwood Springs and Marble, we have climbed nearly three thousand feet, and find ourselves at an altitude of eight thousand feet above sea level.

It is not our intention to extol the beauties of Colorado, nor to devote much space to the history and development of these quarries. It will be well, however, before going into the details of the electrical equipment and hydraulic development, to have a general idea of the quarries and mills, together with their present and future requirements of electrical power. I quote from an address given by the president of the company, Col. Channing F. Meek, at a meeting of the Denver Real Estate Exchange, Denver, April 15, 1908:—

"The existence of this great deposit of white marble in Gunnison county has been known for a great many years. About twelve years ago some of it was quarried by the use of dynamite, and placed in our State capitol. Probably you are not aware of it, but dynamite is about as congenial to marble as it is to glass. The result of that sort of quarrying was that this deposit, more important in my opinion and in the opinion of many who are competent to judge of it, than any deposit in this State, not excepting coal, so far as its value for this and the future time is concerned, was condemned.

"The matter was brought to my attention about four years ago. I read the reports, which seemed to be overdrawn and next to impossible of being true; but after a careful examination of the property I became firmly convinced that here was probably the greatest deposit of white marble in the world, and to-day my opinion of it is confirmed by what is, I believe, the most remarkable white marble quarry opening in the world.

"Of the value of this marble deposit to the State I do not believe a gentleman here has any conception. I doubt sometimes whether those who are concerned with it day by day can really appreciate it. We have over a billion and a half cubic feet of white marble, of which the sample before you may be taken as an average. This vast quantity of marble is so exposed that you can measure it with a rule just as you can measure the cubic contents of this room. We have opened the quarry, and have on the face of the cliff, which is so exposed for a mile in length, a quarry 240 feet long by about 40 feet in width. Because of the contour of the cliff, which permitted the effect of heat and cold through centuries to reach a few feet in from the surface, there was on the out-side marble some slight evidences of this weathering. Now, we have gone in to a point where there is not a single sign of weathering. In one part of our quarry sixty-nine feet of the face is without a crack in any direction, and, had we the equipment with which to handle it, we could take out monoliths of marble as white and pure as that sample and as sound, sixty-nine feet long.

"Our present quarry equipment has a capacity to produce about 700 cubic feet of marble per day, and machinery is en route which will increase our production to 2,000 cubic feet per day by the end of this year. We have erected a finishing plant, which, for its size, is probably the most complete marble mill in the country, and, therefore, in the world, because American marble mills are the best known. By the first of August we shall have increased our finishing plant to a capacity of 750 feet per day, and we are prepared to increase it as rapidly as the need exists. This finishing mill is 674 feet in length by an average of sixty-five feet in width. The overhead travelling crane in front of the mill now in process of erection is 900 feet in length. We have installed a hydro-electric plant of 1,250 horse-power capacity. We have built a railroad from the terminus of the Crystal River Railroad above Red Stone to Marble. We have built machine shops, and have in process of erection a sawmill for lumber with which to box the finished marble. We have built roads, and we are building the town. We are preparing now to work our quarries day and night. It is fair to estimate that within five years from this time our capacity will reach 5,000 cubic feet per day of merchantable product."

**Fig. 1—Pipe Line Construction, Hydro-Electric Development, Marble, Col.**

The first power plant, finished July, 1907, has been in operation since, and consists of a double DeRemer 5-foot water wheel belted to two 200-k.w., 2,300-volt, 60-cycle, three-phase alternating-current generators, running at 600 r.p.m., the speed of the water wheel being 278 r.p.m.

The water from which the power is derived is taken from the Crystal River and brought down in a steel pipe-line, 3,677 feet long, with a fall of 381 feet. Of necessity there are a number of bends, which reduce the effective head by about thirty feet. The pipe at the intake end is 36 inches in diameter, tapering to 26 inches at the power-house. There it is projected through two 3-inch nozzles on to the buckets of the water-wheel.

The site of the intake was selected where three huge boulders diverted the greater part of the water into a single narrow channel, thus reducing the size and expense of the necessary dam. A tunnel 119 feet long was driven through the solid rock, up to and underneath the bed of the river, and tapping it underneath the channel at the intake. At the lower end of this tunnel the pressure-box was located, and here the pipe-line begins. The Crystal River at this point flows in a series of steep falls through a narrow box-like canon, the walls of which are nearly perpendicular cliffs from 1,000 to 2,000 feet high.

The difficulties of laying such a pipe-line are at once apparent. To have driven a tunnel through the rock to the more level ground below would have required an enormous outlay of money and time. A shorter and much cheaper line

* From the Clarkson Bulletin, July, 1909.

was made by blasting a shelf out of the side of the cliff, and on this shelf the pipe-line now securely rests. To accomplish this men were let down by ropes or went down on wooden ladders, fastened to the top of the cliff. They there drilled and loaded holes in the face of the cliff, and were then drawn up out of danger while the blasts were fired.

At one place near the intake the line is carried across the canon on a bridge, supported by cables securely anchored to the cliffs. At another spot a tunnel had to be driven eighty-nine feet through a projecting cliff. It was a most difficult and hazardous undertaking, but fortunately the whole work was completed without a single fatality.

The shelves and tunnels were made large enough to contain two pipe-lines in addition to the one now installed, and the wisdom of this is already apparent, inasmuch as it is already necessary to lay a line to supply water for our second power-house.

The new plant, one unit of which is already installed and in operation, will contain two units, each consisting of a double DeRemer 4-foot water-wheel, with double nozzles, directly connected to a 450 k.w. 2,300-volt alternator.

The DeRemer water-wheels are made by the Dillon Iron Co., and differ from the Pelton wheel in that the buckets

**Fig. 2—Traction Engine entering Mill Yard.**

are ribbed laterally as well as radially. All of the electrical apparatus was manufactured by the General Electric Co., of Schenectady, N.Y.

Each alternator will receive its exciting current from 11-k.w. direct-current generator, driven by its own water-wheel or motor, as the smaller sizes are called. Each exciter was placed on the shaft of its own generator in the old power-house. While this has its advantages in saving floor space and in economy of operation, it has this disadvantage: that a heavy load thrown on the generator momentarily retards the speed of both generator and exciter, and so furnishes a double cause for loss of voltage. The exciters, running at constant speed and provided with their own water-wheels, will insure much better regulation.

The switchboard panels are made of marble from our quarries. They are arranged in the usual manner, one panel for each generator, one exciter, and one distributing panel. The main bus-bars are common to both power-houses. The two plants will run in parallel, giving a capacity of 1,300 kilowatts. Each power-house is equipped with a ten-ton, hand-operated travelling crane to facilitate the handling of the heavy machinery.

Two transmission lines are run from the power-houses: one to the quarry, three miles away, and the other to the finishing mill, a distance of one and a quarter miles. The original line to the quarry consisted of three 75-k.w. oil-cooled transformers, located in a separate building, near the power-houses, which step up the voltage to 6,600 volts; three lines of No. 6 (B. & S.) gauge, bare copper wire, carried in double petticoat brown porcelain insulators, supported on wooden poles. In the transformer-house at the quarry the voltage is stepped down to 440 volts, which is the voltage for all the motors. The transmission loss of this line, including both sets of transformers, is 9 per cent. The capacity of the quarry line is now being doubled, each part with the exception of the poles, being duplicated.

In long distance transmission of power at a high voltage, line losses and sizes of conductors may be calculated to a nicety by the use of the tables of line constants published in electrical hand books or furnished by manufacturers of line wire; but for short distances and moderate voltages more simple methods are commonly used. In our case we have found the following simple formula to be of sufficient accuracy:—

$$A = \frac{D \times W}{P \times E^2} \times K$$

Where A = Area of conductor in circular mils.
D = Distance of transmission (one way) in feet.
W = Total watts delivered at receiving end.
P = Per cent. loss in line of W.
E = Voltage between main conductors at receiving end.

Values of the constant, K, for any particular power factor are obtained by dividing 2,160 by the square of that power factor for single phase, and by twice the square of that power factor for three-phase. The resistance of line wire is taken as 10.8 ohms per mil-foot. In our case, three-phase system and 85 per cent. power factor, K = 1,500.

The following data, together with what has been given above, although meagre, permits of comparison of the efficiency of the two plants.

**Colorado Yule Marble Co.—Hydro-Electric Installation.**

| Power House. | Old. | Old. | New. |
|---|---|---|---|
| Diameter of wheels (feet) | 5 | 5 | 4 |
| R.p.m. of wheels | 278 | 278 | 360 |
| Number of nozzles | 2 | 2 | 4 |
| Diameter of nozzles (inches) | 3 | 3.25 | 2.5 |
| Water pressure (lbs. per sq. in.) | 165 | 165 | 165 |
| Number of generators | 2 | 2 | 1 |
| R.p.m. of generators | 600 | 600 | 360 |
| Volts between phases | 2300 | 2300 | 2300 |
| Power factor (per cent.) | 85 | 85 | 85 |
| Amperes | 96 | 115 | 135 |

The load readings given are those of the greatest load which can be carried, at the rated speed, with the nozzles used and the gate valves wide open. The efficiency of the generators is guaranteed by the manufacturers to be 98 per cent. at full load and that of the water wheels to be 85 per cent.

The uneven and rocky nature of the mountains present difficulties for electric transmission as well as pipe-line laying which can hardly be appreciated by the eastern engineers. In placing the poles for the transmission line from the power-house to the quarry, for instance, fully forty per cent. of the holes had to be blasted out of solid rock.

The quarry equipment consists of one 200 h.p. induction motor, directly connected to a compressor, which supplies the air pressure for the pneumatic channelers, drills, and hoist; one 15 h.p. motor for pumping water; six electric channelers, and one 100 h.p. motor to run the hoisting apparatus.

The power is transmitted to the mill at generator voltage, the original line being of No. 4, bare copper wire. The new line is of No. 0000 copper cable. The poles used have a diameter at the top of ten inches.

At the mill the voltage is reduced to 440 volts and distributed at that pressure.

The old mill contains two 75 h.p. motors, which run the eight gang-saws employed in sawing the marble into slabs and blocks of the desired size; one 75 h.p. and one 50 h.p. motor furnish the motive power for the rubbing beds, polishers, planers, turning lathe, and hoisting machinery.

One 50 h.p. motor is installed in the machine shop across the railroad track from the mill, and another of the same size in the wood finishing shop a short distance away.

In the new mill will be ten 75 h.p. motors; five will keep in continuous operation the twenty-two gangs, and the remainder will operate the finishing machinery. In addition to the outside crane, mentioned by Col. Meek in the abstract referred to (which crane has a span of seventy feet), there will be an electric travelling crane inside the building for conveying the marble blocks from the saws to the finishing-room, and thence to the shipping department.

The road from the quarries to the mill, three and one-half miles in length, is one of the best mountain roads in the State. Formerly a mountain trail, it has been transformed, by months of labor, into a hard, solid road, twelve feet wide at its narrowest point.

At present the marble is being hauled by one 120 h.p. traction engine, drawing four wide-tired, heavy wagons, specially built for this purpose.

This train makes two trips daily, carrying from sixty to seventy-five tons of marble each trip. The wagons are loaded at the quarry by pneumatic hoist and unloaded at the mill by an electrically operated derrick.

This fall it is proposed to build an electric road over this route to transfer the marble from the quarries to the mill. A synchronous motor, direct-connected to a direct-current generator, will furnish the power. With a synchronous motor it is possible to "build up" the power factor of the line, which is necessarily low by reason of the many induction motors used throughout the system.

As the population of Marble increases, and it has doubled the last year, the lighting load becomes more a factor. There are in operation at the present time fifty arc lamps and 700 incandescents, with the number increasing daily.

The demand for power more than keeps pace with the power-house construction, so that as soon as a new generator is installed it is at once put in commission. For that reason no opportunity is given for making tests and little data are available.

## RELATIVE STRENGTH OF CONCRETE.

It is ordinarily assumed, at least by the inexperienced, that the strength of concrete is measured by the proportion of cement in a given mixture relatively to the amount of the other materials—sand and stone. But the fallacy of this assumption is shown by the fact that the total volume of concrete is always less than the sum of the volumes of its ingredients. This is due to the ability of the smaller particles—the cement in a semi-liquid condition and the fine sand—to fill all interstices or "voids" between the larger pieces of stone. More compact concrete can be secured by the use of gravel than broken stone—the angular pieces of the latter frequently arch together, allowing voids to form beneath. In a technical, yet very practical, way this subject is discussed in a recent paper by Mr. Leonard C. Wason, president of the Aberthaw Construction Company, Boston, Mass. He shows that for watertight work gravel is always to be preferred as compared with broken stone.

There is little difference in strength between concrete made by broken stone or by gravel. Mr. Wason has proved by actual test that broken stone having a rough surface with angular fractures will give an increase in strength over rough bank gravel of about 15 per cent. in most cases. In some, however, the gravel has given the greatest strength. This is always true if the stone has a glossy surface such as is found in some trap rocks.

In the first instance, if the specifications required one-three-six broken stone concrete, and there is a difference in cost between broken stone and gravel screenings of two cents per cubic foot, it will be cheaper to use a mixture of one-two and one-half-five with gravel and still obtain an equal strength with the broken stone. Mr. Wason makes the rule never to allow the size of stone in its greatest dimensions to be more than half the thickness of the work into which the concrete is to be placed. In large size work very much larger stone can be used than is ordinarily done with very good results, the only limitation being that of convenience in handling. In regard to placing, it is much easier to obtain dense concrete, that is, without voids, using gravel than using broken stone, as angular pieces will sometimes arch together, allowing a void to form underneath. Therefore, for watertight work gravel is to be preferred every time. For nearly all classes of work the best results will be obtained by using such an amount of water that the concrete when placed will just barely quake, but is not sufficiently soft to flow.

## EXPERIMENTS ON ELECTROLYSIS IN REINFORCED CONCRETE.*

By A. S. Langsdorf.

The possible corrosion of the steel reinforcement of concrete structure is a matter that must appeal strongly to engineers in view of the constantly increasing use of this kind of construction. The subject in general has received considerable attention, but mainly along the lines of the effect of atmospheric action. Some experiments have been made to determine the electrolytic behavior of reinforced concrete, but thus far not on an extensive scale. Probably the most notable publised work in this direction is that of A. A. Knudson, New York, whose results are to be found in the "Proceedings of the American Institute of Electrical Engineers" of February, 1907; this appears to be the first account of an experimental investigation of the subject.

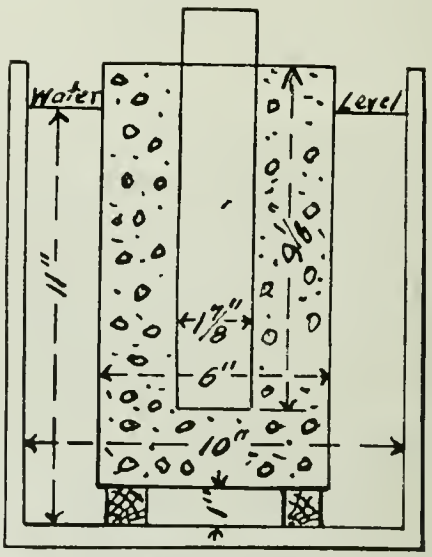


Fig. 1. Arrangement of Specimen for Electrolysis.

The experiments here described were carried out, under the direction of the writer, during the winter and spring of 1908, by M. M. Glauber, at that time a senior student of electrical engineering in Washington University. The work was undertaken as a graduation thesis, and was very carefully done: its general plan was an amplification of that adopted by Mr. Knudson.

The tests made by Mr. Knudson were two in number. In the first test, three specimens (Nos. 1, 2 and 3, respectively) were made by embedding 2-inch pipe to a depth of 8 inches in a mixture of equal parts of cement and sand; the kind of cement is not stated, but from the context it appears to have been a Portland cement. The mold was an ordinary metal pail, so that there was a thickness of between 3 and 4 inches of concrete all around the pipe. The bottom of the pipe was closed by a water-tight plug. The specimens were then placed in water, No. 2 in fresh and a constant current of 0.1 ampere was passed through them from a storage battery, the current entering through the pipe and leaving through the concrete. Specimen No. 1

*Read before the Engineers' Club of St. Louis and printed in the Journal of the Association of Engineering Socities.

had no current through it, in order to compare its condition with that of the other at the end of the test. The test was continued for a little over thirty days, current being on continuously. The results showed an unexpected deterioration of the concrete, and Nos. 1 and 3 in sea water. Specimens two and three were then connected in series and a steady current applied, large cracks appearing in it. There were also strong evidences of electrolytic action on the pipes, a layer of rust having formed upon them which extended into the concrete especially on the walls of the cracks; pitting of the pipes was very noticeable, and there was an appreciable loss of weight.

In the second set of tests two blocks (Nos. 4 and 5) were made, similar to the three others except that Rosendale cement was used. The test run was again continued for thirty days with the current constant at 0.1 ampere. The results were similar to those of the first test, except that No. 4 (in sea water) showed greater electrolytic action, a hole 1" x 3/8 inches having been eaten clear through the pipe. In the first test, No. 1, in sea water, but without current, was absolutely unaffected. A sledge hammer and chisel were required to break it open, and the pipe was clean and bright. In all the other specimens the concrete became soft and crumbly, so that in places a penknife could be easily thrust into it.

### Washington University Tests.

The tests made at Washington University were also divided into two parts, but 12 specimens were used in each part. All of the specimens consisted of 1½ inch pipe embedded to depth of 9⅛ inches in a 1:3:5 concrete made rather wet and thoroughly tamped. The cement was Red Ring brand and the aggregate was crushed limestone. The thickness of concrete all around the pipe was 2 inches. The specimens, after ageing for about 50 days, were placed in six gallon glazed earthenware jars, raised above the bottom by wooden blocks, and were immersed in fresh water to within about 1 inch of the top of the concrete; fresh water was added as necessary to replace loss through evaporation. Fig. 1 shows the details of the specimens.

In the first run eleven of the specimens were then connected in series and a current of 0.05 ampere was passed

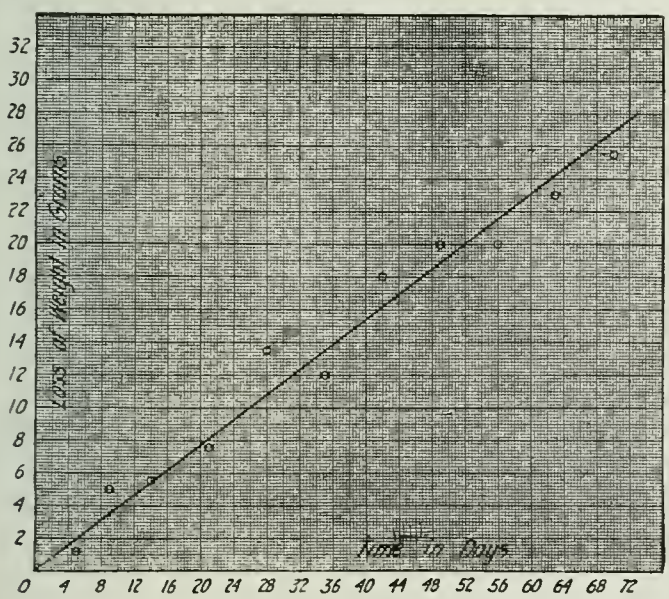


**Fig. 2. Loss of Weight of Concrete by Electrolysis in One Week.**

through them, the twelfth specimen being without current. The run was continued for 70 days continuously. (It will be noted that in this test the current was only half that used by Mr. Knudson, and the run was more than twice as long.) All of the pipes were weighed before embedding them in the concrete. At the end of each week one specimen was removed, broken open, and the pipe cleaned and rewieghed, with the result shown in Fig. 2.

In the second run which continued for 33 days, the specimens were connected as before, but the current strength was raised to 0.2 ampere. The curve showing loss of weight in this case is drawn in Fig. 3; during both runs, readings of the drop of voltage aroun dthe specimens were taken at regular intervals. The apparent resistence per specimen, calculated by dividing the volts per sample by the current, varied in the first run from 660 ohms at the start to about 1,200 ohms at the end; in the second test it changed from about 50 ohms at the start to about 500 ohms at the end. Mr. Knudson found an apparent maximum resistance of from 300 to 400 ohms per specimen, but differences in this respect are to be expected because of variations in the density, or porosity, of the samples. It is to be

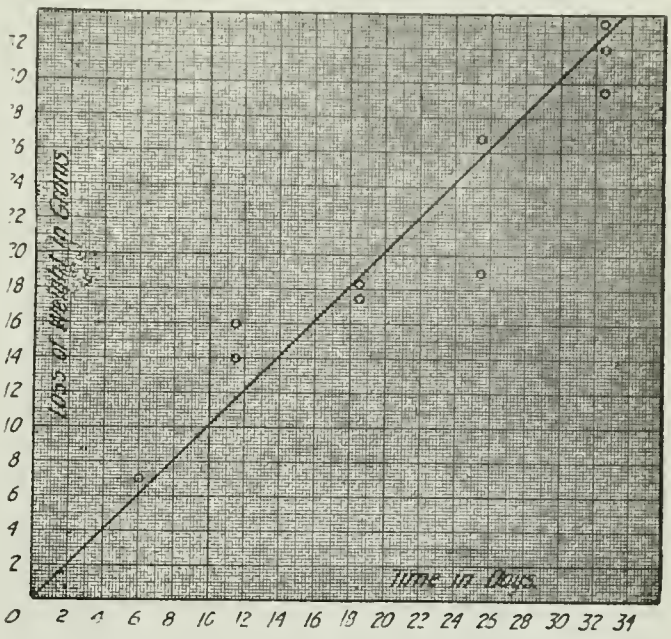


**Fig. 3. Loss in Weight of Concrete by Electrolysis in 33 Days.**

understood that these resistances are apparent only, for they include the effect of a very considerable polarization.

The specimens after their removal from the circuit show large radial cracks that formed in the concrete, and some show also a flaky white deposit that formed on the outside surface. Lack of time prevented making an analysis of this deposit, but this will be done in a further series of tests.

### Softening of the Concrete.

The softening of the concrete observered by Mr. Knudson was confirmed in these tests, but it was not so marked as reported by him, probably on account of the different mixture used. The electrolytic action on the embedded metal was very strong, as shown by the curve of loss of weight. Whereas the specimens not subjected to the current remained clean and bright, the others developed a coating of rust whose thickness increased with the duration of current flow, and in all cases where cracks developed a coating of rust was deposited on the walls of the cracks.

The cracking of the concrete may possibly be explained by the fact that the layer of rust is of rather loose consistency, so that its density is less, and its volume greater than that of the original material, thus giving rise to a bursted force. The fact that the cracks are mainly radial seems to support this hypothesis.

Mr. Knudson's result, as well as those here described, indicates quite clearly that great caution must be used in the construction of reinforced concrete structures where the conditions are similar to those of the tests such, for example, as might be found in the case of bridge abutments or concrete sewers in the neighborhood of grounded railway circuits. Further information is needed as to the extent to which the reinforcement of such structures, when buried in damp or wet earth, may become part of the return circuit of trolley lines; and also to determine the insulating effect of waterproofing ingredients in the concrete. It is the intention of the writer to take up these subjects in a further investigation, and it is hoped that others will also undertake the study of this important subject.

## PARK ORNAMENTATION.

### Extensive Work Carried Out at Lake Park, Milwaukee—Effect of Highy Expensive Stone Shaping Produced in this Material.

An extensive piece of cast stone work is to be seen at Lake Park, Milwaukee. Lake Park overlooks Lake Michigan from a bluff, cut here and there by ravines. The park board built a carriage drive connecting the bluff with the beach, and wished to make a stairway down which those frequenting the park on foot might reach the water easily. At the same time, it was desired to give access to an athletic field being laid out on a natural amphitheatre just above the level of the lake and, moreover, to add an architectural ornament to the park suggestive of Grecian simplicity and dignity. White stone would form the finest contrast with the green of the bank and the blue of the lake, and white was desired but the expense of stone or marble work was so great that cast stone, a process of manufacture rapidly coming into general notice, was decided upon. The results have been very satisfactory to the board.

Starting at a small paved "lookout" in the rear of the park pavilion on top of the bluff, as illustrated, winding stairs descend to a recess containing a sundial. From thence there is a further descent between Doric columns to the lake. Midway in this incline a terrace leads off to the south to the athletic field and to a graceful series of curving seats and steps. The forks into which the terrace terminates are each surmounted with a tall flag pole. The cast stone in this work consists of the Ionic sun dial, a number of Doric columns, some thirty-two pedestals, four hundred feet of balustrade, and two bases for the flag poles each weighing three tons.

The manufacturers of this cast stone work, Messrs. Hutchens & Friske, Milwaukee, were successful in producing balusters and columns with a smooth fine surface and a crystalline whiteness. The fine crystals in the stone add to its attractiveness particularly in the sunlight. The cement steps and concrete walls rough casted with cement were built by the Austin Construction Co. The whole scheme was designed and superintended by Mr. A. C. Clas, of the Milwaukee park board, his work being entirely gratuitous. The cost of the cast stone work was $5,000, and of the entire work $16,000.

Cast Stone Work in Lake Park, Milwaukee.

Cast stone is cast in molding sand as iron is cast. It is a patented process. The molding sand used in this case is a white silica sand brought from Illinois, moistened with water and tamped hard around the wooden pattern which has been made of the baluster or column or other ornament desired. After the pattern has been removed, the liquid concrete is poured through a hole in the top and allowed to stand for twenty-four hours. The baluster, for an example, is then taken from the form and allowed to stand five or six days before the sand still adhering to it is brushed off. It is found that the sand of the mold has absorbed the water from the liquid concrete and left it hard and possessing a smooth, fine finish. The finished product should be left to cure

for sixty days protected from the sun and weather before it is exposed to those elements. This curing seasons it and, with care exercised elsewhere and with proper materials, is likely to prevent any danger of hair cracking.

The composition of the stone cast at Lake Park was lime-stone dust, Chicago AA Portland cement and water with water-proofing and densifier added. Marble dust is often used. The limestone dust used in this instance was brought from Missouri where it is produced from a fine quality of white rock found there. Freight and grinding render it expensive. The cement should be thoroughly aged to weather out any free lime contained in it. Lime may be found in green cement and if such cement is used in cast stone work the lime is apt to be blown by sun and water and to produce hair cracks. The cement should also be as white as possible.

With care taken in the purchase of materials, in conducting the work and in ageing, cast stone may be produced that is very pleasing. Its cheapness as compared with stone is made possible particularly when a large number of pieces are molded from the same mold such as balusters and other parts of this work in Lake Park. Its cheapness will often make possible work of this kind that would otherwise have to be abandoned. That is, the effect of elaborate and highly expensive stone shaping and stone carving duplicating classic architectural models may be and undoubtedly will be produced in cast stone at a cost within the reach of the average builder. Cast stone will be particularly serviceable in large work like the work just described, in viaduct and bridge railings, etc., where the general effect desired would be too expensive if stone were to be used. Cast stone is whiter than Bedford stone and in many cases this will be found to give an effect not possible to secure without the use of marble.

**Cast Stone Work in Lake Park, Milwaukee —Termination of the Terrace.**

## THE REAL VALUE OF STEAM COAL.

**D. T. Randall.***

In general it may be said that a furnace may be designed to burn almost any kind of coal with good efficiency, and that the real value of a coal depends very largely upon the number of British thermal units which it contains. Tests which have been made at the Government Fuel Testing Plant seem to indicate that the most important thing to be considered in a coal is its heating value. Following this, the size of the coal may be considered as next in importance, and when the moisture, volatile matter and ash are widely different they must also be considered. The results of more than 400 boiler tests at the Government Testing Plant show that the average drop in efficiency for a range of coals between 14,000 B.t.u. and 10,000 B.t.u. is only about 6 per cent. This difference is due to the combined influence of the size of the coal and the moisture, the volatile matter and ash in the coal. It will be seen from these figures that the probable influence of any of these constituents is not as great for hand-fired furnaces as it is often thought to be. With certain boiler equipments in which a considerable overload is necessary at times, the effects of these constituents may be obtained, and it is for this reason that when coal is selected for a given plant it is important that the coal supplied should not vary greatly from time to time. Otherwise the fireman may have serious difficulty in maintaining the capacity required, and in burning the coal with good efficiency.

With a furance which is well designed, there should be a close correspondence between the heating value of the coal and the water evaporated. Small variations in moisture, volatile matter and ash should make little if any difference in the efficiencies obtained.

The size of the coal may influence the results to a serious extent. Small sizes of anthracite coal packed together closely, and strong draughts are required to burn them. This results in holes in the fire and a leakage of air in the boiler settings. The loss is often estimated to be at least 10 per cent. This is also true of many of the bituminous coals. Other coals which coke readily, forming a loose bed of fuel, do not show much loss, due to the presence of fine coal, except such as is so small as to be carried off from the grate by the draught. With any character of coal there may be a loss of fine coal, due to sifting through the grates. That this loss may be large is well known. The carbon in the ash is an important item in determining the losses in a boiler room. In many plants care on the part of the fireman has reduced this loss to the equivalent of 2 and 3 per cent. of the fuel fired. Occasionally owners of power plants have purchased for testing purposes a coal of higher grade than they usually furnish for the boiler furnaces. The results obtained have often been disappointing, and without further investigation they have declared that the plan of purchasing coal on the basis of its heating value is at fault and that corresponding results cannot be obtained from the higher grade coals. On the other hand it has happened that others have tried coals of lower heating value than the coal regularly burned in their plant, and they often find a greater drop in the evaporation than they expected. This has led many people to believe that there is a great difference in the value of coals for only slight variations in the composition.

Boiler tests are a rather crude method of comparing coals, especially if the fireman is not accustomed to burning the coal to be tested.

A chemical laboratory test is conducted under conditions which may readily be duplicated, and the results are therefore more reliable than boiler tests.

* Engineer in charge of the Fuel Engineering Department of the Arthur D. Little Laboratories, Boston, Mass.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Canadian Forestry Association.**—At Regina, Sask., September 3rd and 4th. Special meeting. James Lawlor, 11 Queen's Park, Toronto, Ont.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received up to noon on Tuesday, 14th September for the enlargement of the city's aqueduct, by widening and deepening the same on a length of about 27,300 feet. The work comprises about 1,176,000 cubic yards of earth excavation and about 400,000 cubic yards of rock excavation, also the formation of the slopes and banks of the widened aqueduct, the transporting to a distance of excess of excavated material, the construction of syphon culverts, the construction of dry stone wall lining in the slopes, etc., etc., the whole according to plans, cross-sections and specifications, to be obtained from George Janin, superintendent and chief engineer of the Montreal Waterworks, City Hall. (Advertised in Canadian Engineer.)

MONTREAL.—Tenders for electric light wiring and fittings for the addition to Montreal Post Office will be received until 5 p.m., Wednesday, August 25. Plans and specifications to be seen on application to A. Venne, architect, Montreal, and Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**Ontario.**

GODERICH.—Tenders will be received up to noon of August 31st, for the erection of a nine-roomed public school, in the town of Goderich. Plans and specifications may be seen at the office of A. J. Barclay, architect, Crown Life Building, Toronto, or A. D. McLean's clothing store, The Square, Goderich.

TORONTO.—Tenders will be received up to 12 o'clock noon on Monday, August 23rd, for Bridges and Culverts on the wagon road from the Montreal River at Smyth to Gowganda as follows: One bridge at Lost Lake, 290 feet long, with approaches. Two bridges at Long Point Lake, 25 feet long, with approaches. Four bridges between Lost and Leroy Lakes, 25 feet long, with approaches. Two bridges at Miller Creek, 25 feet long, with approaches. About 400 feet of side hill bridging near Lost Lake. And about 45 culverts. The work is to be completed by the first of October, 1909. Plans and specifications and tender forms may be seen at the office of C. H. Fullerton, Engineer, New Liskeard, or F. Cochrane, Acting Minister of Public Works.

TORONTO.—Tenders will be received until Thursday, October 14, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 14, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

AMULREE.—Tenders will be received up to Friday, August 27, for the $3,695.40 debentures for drainage works. J. D. Fisher, Township Clerk, Amulree P.O., Ont.

PARKHILL.—Tenders for electric light fixtures, etc., will be received until Monday, August 23. Plans, etc., to be seen on application to James Phelan, Clerk of Works, Parkhill; T. A. Hastings, Clerk of Works, Customs Building, Toronto. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—A number of timber and tie berths in the districts of Algoma, Sudbury, Thunder Bay, Kenora, and Rainy River, Ont., will be offered for sale by public tender on Wednesday, September 15th. For plans, etc., apply to F. Cochrane, Minister, Department of Lands, Forests and Mines.

ORILLIA.—Tenders will be received until 8 p.m. Thursday, September 9, for constructing the following works: Contract "A," Sanitary Sewers, about 15,000 lineal feet. Contract "B," Sewage Pumping Station. Contract "G," Sewage Pumping Machinery. Contract "O," Force Main, about 7,000 feet iron pipe. W. C. Goffatt, Mayor, Orillia. Willis Chipman, C.E., chief engineer, Toronto, Ont.

TORONTO.—Tenders will be received until Monday, October 4th, for erecting the Wilton Avenue Bridge. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in the Canadian Engineer.)

LOCHIEL.—Tenders will be received until Wednesday, August 25th, for the construction of a drain. Total length of excavation 19,700 feet; total estimated excavation 11,300 cubic yards, of which 206 cubic yards are hard pan. Plans and specifications may be seen at the office of Magwood & Walker, civil engineers, Cornwall, On.; V. G. Chisholm, clerk.

GUELPH.—Tenders will be received until Tuesday, August 24th, for the construction of three concrete bridges. L. Malcolm, city engineer. (Advertised in the Canadian Engineer.)

**Manitoba.**

WINNIPEG. — Tenders will be received by Winnipeg Public School Board up to Monday, August 30th, for a heating and ventilating plant to be installed in the Greenway School. For plans, etc., apply to J. B. Mitchell, Commissioner of School Buildings, School Board Office; R. H. Smith, secretary-treasurer.

**British Columbia.**

VANCOUVER.—Tenders will be received up to Monday, September 6th, for grading and bridging of the Alberni branch of the Esquimalt and Nanaimo Railway Company from the 108th mile to Alberni (27½ miles). See Mr. Bainbridge, Division Engineer E. & N. Railway, Victoria; Mr. H. J. Cambie, Chief Engineer, E. & N. Railway, Vancouver, for plans, etc. R. Marpole, vice-president.

VICTORIA.—Tenders are invited until September 15 for the supply of about nine hundred tons of cast iron socket pipes and special castings. T. Lubbe, secretary, Esquimalt Waterworks Company.

VICTORIA.—Tenders will be received up to Saturday the 28th August for constructing and completing sections 2, 3, 4 and 5, in all ten miles in length, more or less, of the Vancouver Island Trunk Road. Plan, profile, drawings, specifications and forms of contract and tender may be seen. F. C. Gamble, Public Works Engineer, Department of Public Works.

VICTORIA.—Tenders will be received up to Saturday the 21st August for the cables and metal required in connection with a suspension bridge over the Fraser River, to be delivered at Lytton, B.C., on or before the 30th October, 1909. Drawings, specifications, contract and forms of tender may be seen at the office of R. J. Skinner, timber inspector, Vancouver, and at the office of the Government agent, New Westminster. F. C. Gamble, Public Works Engineer, Public Works Department, Victoria.

## CONTRACTS AWARDED.

**Quebec.**

SHERBROOKE.—Mr. C. Beauchesne, manager of the Sherbrooke Construction Company, has secured a contract for new buildings to be erected in Sherbrooke by the C.P.R. These include a station, engine house, coal chutes, and a

machine shop. The contract price is in the neighbourhood of $40,000.

**Ontario.**

TORONTO.—Contracts have been let for the construction of the first Government wagon roads north of the Height of Land, by the Provincial Department of Public Works. From Matheson on the Temiskaming and Northern Ontario Railway, seven miles of highway will run eastward, while from Cochrane, the terminus of the Ontario Government Railway, nine miles will be built in a northerly direction. The contractor is Mr. D. H. Black, of Parham, Addington.

TORONTO.—Contracts for the remaining transformer stations in connection with the building of the Government power transmission line were awarded by the Hydro-Electric Commission on August 11th. The only remaining contracts to be let in connection with the whole construction of the line are for the portion of the mechanical equipment comprising cranes, heating and water-piping. The contracts for the erection of the stations at St. Mary's, Stratford, Berlin and Guelph, were awarded to Messrs. Edge & Gutteridge, of Seaforth, at $18,700 each, while those at Preston, Paris, Woodstock, and St. Thomas, went to John Hayman, of London, at $19,850 each. The contract for the supplying of 12,000 galvanized clamps to carry the cable was given to Messrs. Pratt & Latchford, of Brantford, the lowest tenderers. The total price will be about $6,000.

NIAGARA FALLS.—A meeting was held on Saturday evening to consider tenders for the construction of walks, gutters, and face walls for the Kitchener Street and Glenview public schools. The tender of J. S. McCracken, which was 11½ cents per foot and $611.60 for the whole work, was accepted. Work will begin on the improvements at once.

ST. THOMAS.—A. Sells, of Port Burwell, was given the contract for building a new road on Kane's Hill, at $3,000. The contract was let by auction, City Engineer Bell acting as auctioneer.

TORONTO.—The Provincial Government has awarded contracts for the construction of seven miles of roadway east from Matheson and nine miles north from Cochrane to D. H. Black, Parham, Addington County, who submitted the lowest tender. The proposed work signalizes the advent of the first Government wagon roads north of the height of land. It is proposed to further extend the roadway work in opening up the district.

TORONTO.—Contracts were awarded by the Provincial Public Works Department to Edward Gearing, of Toronto, for enlarging the boiler house at the Normal School for $2,345 and for painting Osgoode Hall to R. J. Hovenden for $2,200.

GUELPH.—The Light and Power Commission for the corporation of the City of Guelph have awarded a contract to Messrs. Vandeleur & Nichols for the supply of two large frequency changer sets and switchboards, and for the supply of motors, manufactured by the Lancashire Dynamo and Motor Company, aggregating about 1,600 horse-power.

**Saskatchewan.**

SASKATOON.—Tenders for the new Collegiate Institute were opened recently, and the contract awarded to the lowest bidder. The following quotations were submitted: Brandon Construction Company, $93,669; Garson Harnes Company, $92,945; S. Brown, Winnipeg, $92,870; Mooers & Wells, $91,650; Neil Stuart, $89,497; Smith Bros. & Wilson, $87,500, and the Saskatchewan Building and Construction Company, of Regina, $84,555. The contract was therefore awared to the last mentioned firm, their contract price being $9,114 lower than the highest bidder.

MOOSE JAW.—The City Council have let contracts as follows: Concrete bridge, the Parsons Construction and Engineering Company, at $7,490; the plank walk, George Fitchett, 29c. per lineal foot; concrete walks, Navin Bros.

REGINA.—The following contracts have been closed by this city: Canadian Westinghouse Company, Ltd., one 500 K.V.A. low pressure turbine generator unit with switchboard panels and instrument, at a cost of $15,000 f.o.b. Regina. Canadian Westinghouse Company, Ltd., one exciter unit, consisting of Westinghouse horizontal turbine, direct connected to Westinghouse direct current Turbo generator to cost $1,768. C. H. Wheeler Manufacturing Company, one C. H. Wheeler improved surface condenser, $4,500.

**Alberta.**

LETHBRIDGE.—The City Council acting on the advice of Smith, Kerry & Chace, their consulting engineers, and the local engineers, Messrs. Arnold & Reid, gave the contract for the coal and ash conveyers for the new power plant to Babcock & Wilcox, of Montreal, for $7,775.

EDMONTON.—Charles May of this city has been awarded the contract for the construction of the sub-structure on the Macleod River and Wolf Creek bridges, the cost of which will be in the vicinity of a quarter of a million dollars.

**British Columbia.**

VANCOUVER.—The fire committee is considering the following tenders for a new patrol auto:

| | |
|---|---|
| F. Darling & Co., 50-60 h.p. | $6250 |
| E. P. Browning, 52-90 h.p. | 5600 |
| E. P. Browning, 45-35 h.p. | 5300 |
| E. P. Browning | 5000 |
| Storey & Campbell, 40 h.p. | 4950 |
| W. J. Massey & Co | 4500 |
| C. W. Sancliffe & Co., 40 h.p. | 5300 |

FERNIE.—A. J. Watson will build the new fire hall for $12,160. The contract was originally given to Al. Rizztuo, at $10,420. Mr. Rizztuo afterwards asked to increase his figure to $11,820, but it was thought inadvisable by the council to create the precedent of allowing tenderers to change their figures.

**Foreign.**

PORTLAND (ME.).—The Aberthaw Construction Company, Boston, Mass., have recently taken contract for adding three storeys to the Crocker warehouse on Cumberland Avenue, owned by the Portland Savings Bank, E. F. & F. H. Fassett, architects. The existing building is a five-storey reinforced concrete structure, which the Aberthaw Company erected several years ago. The columns will be reinforced to carry the extra weight of the additional floors, and the building completed to correspond with its existing design.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—Grading on the C.P.R. double track between Vaudreville and Finch will be completed next week, and the track laying will be executed in the fall. J. P. Mullarkey, contractor for this work, which represents fifty-five miles of construction, says the whole of the building operations will be executed in time to give the C.P.R. a double track all the way from here to Smith's Falls before the end of the year. This is to be an essential part of the company's grain line from Victoria Harbor on Georgian Bay to Montreal, by way of Peterborough.

**Ontario.**

NORTH COBALT.—The grading for the electric railway from Cobalt to Haileybury is almost completed. The only delay now is that the Haileybury end where in deference to the representations of many citizens, the proposed line has been slightly altered. The change will not hamper the work, which will now be pushed with renewed effort.

OTTAWA.—Notice is given of the intention to apply to Parliament for a charter for the Rainy River Radial Railway Company, with power to build from the international boundary to Fort Francis to the Lake of the Woods at the mouth of Big Grassie River, with branches to Long Sault Rapids and with power for telephone, express, light, heat and power business.

**Manitoba.**

WINNIPEG.—The last party of Hudson Bay engineers, in charge of W. J. Clifford, arrived back from the north last Friday. They located the route from Split Lake to Fort

Churchill, and encountered no difficulties in all the two hundred miles. Since April they have been busy taking soundings in Churchill harbor. They have also inspected Nelson, and report that excellent harborage can be secured at either point.

WINNIPEG.—S. C. Hill & Son, who for the past three years have been engaged in bridge construction for the National Transcontinental east of the city, are moving part of their plant to Alberta this week, where they will be engaged in similar work for the Grand Trunk Pacific and the Calgary branch. Mr. Hill has secured the contract for the erection of the bridges on the first fifty miles of this branch. The outfit will be taken to Tofield on the G.T.P., from which point the teams will be driven in to the point where the first bridges are to be built. Of these latter there are two large structures, one over the Battle River, three thousand feet long and one hundred and fifteen feet high, and one smaller bridge eight hundred feet long. Mr. Hill has still to build the bridge over the Seine River east of the city and to complete one or two smaller structures, but with this exception all the work on his contract on the National Transcontinental is done. The bridge over the Seine will be built as soon as the course of the railway into the city through St. Boniface is determined.

WINNIPEG.—The announcement was made from the offices of the Grand Trunk Pacific recently that Smith Bros. & Wilson, of Regina, have been awarded the contract for the erection of over forty station houses along the main line, between Winnipeg and Edmonton. All of these stations will be of a modern and artistic type, and the majority will cost in the vicinity of $5,000, while several will run as high as $10,000. Some of the points where these will be erected are Scott, Earl, Lazare, Kelliher, Punnichy, Seamans, Allan, Meighen, Ingloc, Justice, Hope, Uno, and Asquith. The Grand Trunk Pacific is spending a very large amount of money in whipping the western line into first-class shape, and the money spent on new buildings will figure into the hundreds of thousands.

WINNIPEG.—E. J. Chamberlin, vice-president and general manager of the Grand Trunk Pacific, has under consideration the bids for the construction of a most important section of that road. The contract calls for the completion of the dump through a somewhat rough country, extending from the Copper River, which is the east end of the present contract, east to Aldermere, a distance of 130 miles. In this division it is estimated that there are 1,500,000 cubic yards of rock to be removed. At a somewhat high estimate, it is computed that it will cost from $2 to $3 a yard to move this rock, which would mean an expenditure of from $3,000,000 to $4,500,000. The entire cost of the construction of the dump for the distance is estimated at from $5,000,000 to $6,000,000. For the first one hundred miles of construction from Prince Rupert east, the Grand Trunk Pacific will have to pay about $8,000,000. This contract is now being completed by the firm of Foley, Welch & Stewart, who expect to get through with their work in October. The expenditure of $8,000,000 on this hundred miles is explained by the fact that a great deal of work is being done at Prince Rupert, and that the work of the hundred miles is chiefly in a rocky country. The contract which is now being considered is for work through a country presenting fewer engineering problems and with less rock work.

**British Columbia.**

VANCOUVER.—Macdonell, Gzowski & Company, who had the contract for constructing the spiral tunnels in the Rockies, by which the "Big Hill" grade on the C.P.R. main line will be greatly reduced, was in the city recently closing up accounts in connection with the work. The whole of the contract, which is the biggest piece of tunneling ever carried out in Canada, was completed and handed over to the company some days ago.

VANCOUVER.—Owing to the big increase in the traffic on the lines of the British Columbia Electric Company, and with a view to future developments on the new lines, whose construction is nearing completion, a new appointment has been made by the company of an assistant to F. R. Glover, the assistant manager, to have special charge of the Chilliwack line. S. L. Prenter, who for twenty-four hours has been associated with the C.P.R., has been given the appointment. Mr. Prenter is one of the best known railway men in Vancouver.

## CEMENT—CONCRETE.

**Quebec.**

SHERBROOKE.—Considerable cement will be used in the construction of new buildings to be erected at this point by the C.P.R. The Sherbrooke Construction Company have the contract.

**Ontario.**

GUELPH.—As will be seen by our advertising pages, Mr. L. Malcolm, city engineer, invites tenders for the construction of three concrete bridges, approximating 700 cubic yards of concrete.

NIAGARA FALLS.—J. S. McCracken has secured a contract from the School Board for concrete walks at 11½c. a foot.

**Saskatchewan.**

MOOSE JAW.—A contract for a concrete bridge to cost $7,490 has been given to the Parsons Construction & Engineering Company, and one for walks to cost $13,495 has been awarded to Navin Bros.

**Foreign.**

NEW YORK.—In the construction of the foundations for the railroad terminal that is being built by S. Pearson & Son, Ltd., at Vera Cruz, Mexico, approximately 3,000 Raymond concrete piles will be employed.

## LIGHT, HEAT, AND POWER.

**Ontario.**

TORONTO.—The hydro-electric terminal station in Toronto is to be located on Garrison Common, at the foot of Strachan Avenue, if the Board of Control's suggestion is adopted. The station will be 400 feet long and 200 feet deep.

**Quebec.**

MONTREAL.—After October 1st the Montreal Light, Heat and Power Company will allow a discount of 33⅓ per cent. on five-year contracts. The present rate is 15 per cent.

## SEWERAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—Mr. George Janin, superintendent of the Montreal Waterworks, invites tenders until September 14th for waterworks extensions.

**Ontario.**

NORTH TORONTO.—In future the work of sinking water mains will be let by contract in this municipality.

**British Columbia.**

VANCOUVER.—The demand of the city for sewer pipe this year has been so great that the plant from which the supply is usually obtained has been totally unable to keep up with the demand. Thirty carloads have been brought in from Seattle and St. Louis and other shipments have been ordered. In addition, 10,000 feet of 10-inch pipe has been ordered from the Old Country.

## FINANCING PUBLIC WORKS.

The following municipalities have sold debentures:—Blandford Township, Ont., $4,022.70; Red Deer, Alta., $4,500; Whitewood, Sask., $4,000; Nokomis, Sask., $8,000; Delta, Man., $10,000; Sydney Mines, C.B., $25,000; Hawkesbury, Ont., $9,400; Killarney, Man., $10,000; Invermay, Sask., sidewalks, $1,000; Carleton County, N.B., $26,000; Madawaska County, $12,000.

**Ontario.**

GUELPH.—The ratepayers will vote on by-laws to authorize the erection of two new bridges, and also for local improvements, the cost of which will be covered by the issuance of debentures.

ORANGEVILLE.—The by-law to raise $7,800 for the purpose of erecting bridges in the township of Amaranth was carried by a majority of 37.

BARRIE.—The by-law granting a loan of $20,000 to the Barrie Carriage Company for the extension of its plant, was passed.

PORT ARTHUR.—The following by-laws have passed: $25,000 a year for ten years, and a free site, to the Western Drydock and Shipbuilding Company, who will erect a million dollar plant; $3,500 to purchase the plant and equipment of the Bell Telephone Company; sewerage and waterworks extensions and double-tracking street railway.

**Manitoba.**

ST. BONIFACE.—The ratepayers will vote on by-law authorizing the raising of $10,000 for the erection of a clock tower on the city hall.

ST. VITAL.—The municipality have read for the first time a by-law to provide for a supply of water. E. A. Poulain is secretary-treasurer.

**Quebec.**

HULL.—August 30 has been fixed as the date upon which the citizens will vote on a by-law to raise $115,000 for civic purposes.

LA COTE DES NEIGES WEST.—Until Aug. 17th for $15,000 5 per cent. 25-year bonds, L. A Guimond, secretary-treasurer, will receive tenders.

**Saskatchewan.**

MOOSE JAW.—$35,000 electric light extension, $10,000 bridge, and $25,000 school debentures are offered for sale by this municipality.

WEYBURN.—This town will sell debentures to complete the waterwork system. The issue amounts to $75,000, which will make the total debenture liability of the town approximately $150,000.

MOOSE JAW.—This city will issue $45,000 debentures to cover the cost of constructing walks.

MELVILLE.—The citizens have passed a by-law authorizing the expenditure of $6,000 for drainage.

PRINCE ALBERT.—A by-law to raise $2,758 for sewer extensions has passed.

**Alberta.**

LETHBRIDGE.—A by-law to raise $28,000 for extensions to the electric light plant and for improvements to other city property, aggregating $90,000, will shortly be submitted to the ratepayers.

**British Columbia.**

VICTORIA.—The waterworks loan guarantee by-law which authorizes the borrowing of $1,350,000 for the purpose of expropriating the works of the Esquimalt Waterworks Company, and running a pipe line to Goldstream in order to take water supply from there instead of from Thetis Lake, will be voted on by the citizens on Thursday, August 26th.

## TELEPHONY.

**Ontario.**

TORONTO.—The entire telephone system of the Temiskaming and Northern Ontario Railway between North Bay and New Liskeard is being reconstructed. Two gangs of men are now engaged in the work; which will be completed in about two months. The new system will be equipped with all the most modern improvements, and will be designed to provide a convenient and efficient service to the mines and the settlers of the district. In the new depot at Cobalt an up-to-date switchboard will be installed to give a connection with the mines. The line will also be extended along the Kerr Lake branch to Kerr Lake Station, where a switchboard will be located to furnish the mines of that section with means of communication with the outside world. It is the hope of the commissioners that the line will ultimately be extended to Cochrane, the terminus of the provincial railway.

**British Columbia.**

VICTORIA.—The British Columbia Telephone Co. has completed a long distance line between this city and Cumberland. The line was formally opened last week. It has been in course of construction for the past six months, and is all of copper, making the transmission perfect. Nanaimo was the farthest point north reached by the telephone system formerly. The new line adds another seventy miles of wire, and gives communication with Parksville, Little Qualicum and Union Bay. At the present time the company is installing a branch exchange in Cumberland and in Courtenay. From this point it is proposed to extend the line up the Courtenay Valley and down to Comox Bay.

## MARKET CONDITIONS.

Montreal, August 19th, 1909.

Reports from the United States are satisfactory, so far as the markets for pig iron are concerned. There is always a dull spell at this time of year, so that the lack of trade at the present moment is in no way discouraging. The tone is hopeful, though here and there arise complaints that trade is not so active as it should be. The entire market is looking forward to a considerable improvement this fall and the predictions of a head official of the United States Corporation that next year should witness the biggest year's business the company ever had, is not being lost sight of. There has been quite a large enquiry from railway sources for supplies of different kinds, and large orders are being placed from time to time. No price advances have taken place in pig lately, although purchases cannot be made for future delivery at as low figures as for spot iron. This, however, is not altogether an unusual situation, it being doubtful if futures have been other than higher than spot even during the depression.

In Great Britain, the improvement reported a week or so ago continues to make itself felt. Iron prices are firmly held and changes are taking place in them from time to time without any very permanent alteration being noticeable, quotations being up one day and down the next. However, the present average is undoubtedly higher than that of a few weeks ago, and the improvement continues. The home trade is all that could be expected, and although there is little export to the Continent, there is some to Canada whence some orders for delivery before the close of navigation, are commencing to arrive.

Locally, the situation continues steady. Trade is moderately active and the outlook for prices in the future is very firm. Orders are now being placed for fall delivery and it looks as though the consumption would be fairly active. In the list of products mentioned below, very few changes have been made, spikes being firmer, however, and some lumber prices being lower, although the lumber market is fairly hopeful:

**Antimony.**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.90 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1¾ and 2-inch tubes, 8¾c.; 2¾-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 13¾ to 14c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¼ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 15c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¼ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, on dock, Montreal: No. 1 Summerlee, $20; selected Summerlee, $19.50; Clarence, $17; Midland or Hamilton pig is quoted at $19.50 to $20, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50; Carron soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.10 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 3c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $31 for

5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ¼, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32 to 32½c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

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Toronto, August 19th, 1909.

The local market is quiet and price changes are trifling. The demand for brick is still good as is also the case with lumber.

The demand for pig iron greatly exceeds the supply and prices are sure to rise. Copper on the other hand is quiet and although there are many enquiries there is no great rush of purchasers.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Season over, nothing doing.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, and sales have been made within the month at 5c. less than this. Until the consumption increases, prices will not improve. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market outside is higher and was excited yesterday. But we quote still $13.85 to $14.05 in this market, with a fair movement.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10%, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—The local demand for stuff is maintained, but there is not so much doing outside. Southern pine continues to move, and the stock on hand is depleted. Spruce flooring is not so much heard of here, since better prices can now be had for spruce at home in New Brunswick and Quebec. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—More demand during the past few days, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—After some ups and downs this week the London market showed an advance. We still quote 31c. to 31½c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12½c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, new, 6 to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, 7½ to 9c.; fancy, 11 to 12c.; extra fancy, 14½ to 15c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Now quite scarce. Tierces, 14½c.; tub, 14¾c.; pails, 15c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Short cut, $25 to $26 per barrel; mess, $23.50.

**Potatoes.**—Ontario, old, 75 to 90c. per bag in car lots on track.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 13¾c. to 14c.; firm, tons and cases; hams, large, 13 to 14c.; small, 15½ to 16c.; rolls, 13 to 13½c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.75 per 100 lbs. in barrels; Acadia, $4.65; yellow, $4.35; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 18 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, August 17th, 1909.

The local market is quiet but the demand for small lines continues steady and there is nothing of special importance to record. Favorable building conditions still continue, and the number of dwellings that are being erected in the residential portion of the city is surprising and the demand for builders material keeps business with the supply dealers fairly steady. Lumber is in good demand also shingles and lath. The hardware dealers report a good demand for building paper and wire nails. Harvesting operations are now on in the country and country orders are practically at a standstill. The mid-summer hot weather and holiday season is also having its effect on the market, but for all this it is surprising how the demand for small lines keeps up.

Approach to Huntley Street Bridge, Rosedale, Toronto, treated with "VULCAN FLUID ASPHALT" under direction of City Engineer, Roadway Department.

GOOD ROADS AT LITTLE COST.

# VULCAN FLUID ASPHALT

## MADE IN CANADA

A manufactured product carrying Asphalt in solution—entirely free from all the objectionable features of Crude Oil—sanitary and wholesome—a road builder—after one application roads remain dustless for a year or longer. We invite inspection of this product where it has been used on the streets of Toronto—**"the proof of the pudding is in the eating."** We guarantee it. Call and see us. Send for booklet.

## The British American Oil Co., Limited

Offices 6 KING WEST Refiners - TORONTO, ONT.

"That obtained from The British American Oil Co., I think, is the preferable oil"—Dr. Sheard on Road Oil in "Canadian Engineer," July 16th, 1909.


Cement is again somewhat quiet and prices are pared down very low. A good demand is also noted for a better class of brick this season.

Winnipeg quotations are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in. $55; cull red or white pine or spruce $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft. $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $8 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $12 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coppered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hair.**—Plaster's, 80 to 90 cents per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 63 per cent.; screw hook and hinge, 6 to 10 inches, 5¾c. per lb.; 12 inches up, per lb., 4¾c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.10; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00, 2 x 20 up to 32 feet, $36.50.

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

**Picks.**—Clay, $5 dozen; pick mattocks, $6 per dozen; clevisbes, 7c. per lb.

**Pipe.**—Iron, black, per 100 feet. ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ¼-inch, $4.25; ⅜-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.


## Bar Steel

IRON FINISH SMOOTH FINISH

REELED

At low prices for satisfactory qualities

**A. C. LESLIE & CO., Limited**

MONTREAL


## POSITIONS VACANT

Advertisements under this heading, two cents a word. Displayed $1.50 an inch.

**WANTED.**—Bridge and Structural Draftsmen. Dickson Bridge Works Company, Campbellford, Ontario.

**Pitch.**—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¾ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¾c.; British Manila, 11¾c.; sisal, 10½c.

**Spikes.**—Basis as follows:—1¾ x 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 100 lbs.

**Timber.**—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Tool Steel.**—8¼ to 15c. per pound.

**Wire.**—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 gauge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, AUGUST 27th, 1909. No. 9

## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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| Three Months - | 1.00 | Three Months - | 1.25 |

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**HEAD OFFICE: 62 Church Street, and Court Street, Toronto**
TELEPHONE, Main 7404.

**Montreal Office:** B33, Board of Trade Building. T. C. Allum, Business and Editorial Representative, Phone M 1001.

**Winnipeg Office:** Room 315, Nanton Building. Phone 8142. G. W. Goodall Business and Editorial Representative.

**London Office:** 225 Outer Temple Strand T. R. Clougher, Business and Editorial Representative, Telephone 527 Central.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

**NOTICE TO ADVERTISERS**

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TORONTO, CANADA, AUGUST 27, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## THE LATE ROBERT REID.

Mr. Reid was not an engineer, but a successful merchant and manufacturer of London, Ont. Five years ago he was selected by the Dominion Government as one of the commissioners of the National Transcontinental Railway.

The good judgment he has shown as a commissioner, the care and energy and tact displayed by him has made clear the wisdom of the choice, and he will be greatly missed.

The work of the Commission is but half done. The remaining years will be trying years, and a competent successor to Mr. Reid will be very necessary.

In selecting the first Commission the Government deliberately avoided appointing men to the Board who had some knowledge of engineering and construction contracting methods, and the folly of such a course has led to blunders, and worse. In the middle of the stream they are found swapping horses. The engineering staff and the contractors are chafing under orders, directions and intimations that would not come from a board of strong engineers and contractors.

It is just as senseless to ask a tailor—no matter how good a tailor he might be—to build a railway, as it would be to appoint a grocer to a judgeship or a farmer to be health inspector at a port of entry.

The National Transcontinental Railway is not a scheme for a clever promoter. The financing is looked after by a Government Minister. The possibilities of the road being a money-maker were discussed and decided by the Dominion Cabinet.

The National Transcontinental to-day is an engineering-contracting problem, and to be successfully handled must not be nursed by lawyers, manufacturers, merchants, but given over to specialists in that class of work—the engineering-contractors.

It is no argument to say that the railroads of Canada are controlled by business men—not engineers. Quite true; but they hand over construction to trained men and do not interfere. Construction is the work of the Commission.

If manufacturers and merchants compose the N.T.R. Commission, why not engineers for the Tariff Commission?

## AVIATION.

The meet at Rheims this week tends to draw attention to aeroplanes, extended flights and aviation.

A few years ago the wireless accomplished the well-nigh impossible, and startled the world with a message transmission that appeared uncanny. This year the aeroplane has demonstrated the possibilities of a new method of transportation, and the air is full of machines, imaginary and real, and the daily press has a new subject that will stand for "copy" at any time when real news is scarce.

Progress in mechanical flight is dependent upon the reliability of the motor, and the high-class racing car has led to the development of such a light, durable, reliable machine that aeroplanes have been kept afloat for two hours and more, the giving out of the fuel accounting in most cases for the limit of flight.

The distance covered and the rate of speed during these flights is difficult to determine. The record at Rheims, according to the latest despatch, gives 6 1-5 miles in 8 minutes 35 2-5 seconds as the best time.

In a recent book on "Aerodynamics," Mr. Lancaster makes some interesting calculations. As an indication of the greatest distance which could possibly be covered with the aid of the most concentrated form of fuel known, he mentions that an aeroplane carrying its own weight of liquid hydrogen as fuel could fly 86,600 miles without alighting. Using liquid hydrogen as fuel and carrying 25 per cent. of the total mean weight of the machine, assuming a yet unheard-of thermal efficiency of 50 per cent., a total mechanical efficiency of 90 per cent., and a propeller efficiency of 70 per cent., with a minimum gliding angle of six degrees, the exhaustion of fuel will be complete after a flight of 6,800 miles distance.

The distance covered and the time of flight which will indicate the winner of the $10,000, the Grand Prix de la Champagne, will surely establish a record.

## LEGAL NOTES.

For over a year we have been running monthly a series of articles dealing with court decisions that are of interest to contractors and engineers. This department is being appreciated and frequently referred to—**but have you ever read it?**

It is not expected this department will make lawyers of engineers, but an intelligent reading of the reports will train a man in avoiding litigation, and impress upon him the necessity of great care and a reasonable amount of forethought.

Take the first case mentioned in this department this week. It would naturally be expected that one hole was one hole, yet the defendants "had to be shown."

We commend this department to those of our readers who in the past have neglected it.

Read it once and you will always read it.

## THE CANADIAN PACIFIC RECORD.

The published statement of the Canadian Pacific Railway for the financial year ending June 30th shows a net earning of almost twenty-three million. To be more exact, the figures are:—

| | |
|---|---|
| Gross earnings | $76,313,321 |
| Working expenses | 53,357,748 |
| Net earnings | 22,955,573 |
| Expenses per cent. of earnings | 70.0 |
| Profits per cent. of earnings | 30.8 |

Reading these figures with the returns for the last eight years, it will be noticed that since 1902 the earnings have doubled.

| | Gross earnings. | Working expenses. | Expenses p.c. of earnings. |
|---|---|---|---|
| 1909 | $76,313,321 | $53,357,748 | 70.0 |
| 1908 | 71,384,173 | 49,591,807 | 69.4 |
| 1907 | 72,217,527 | 46,914,218 | 64.9 |
| 1906 | 61,669,758 | 38,696,445 | 69.5 |
| 1905 | 50,481,822 | 35,006,793 | 69.3 |
| 1904 | 46,469,132 | 32,256,027 | 69.2 |
| 1903 | 43,957,373 | 28,120,527 | 64.0 |
| 1902 | 37,503,053 | 23,417,141 | 62.2 |
| 1901 | 30,855,203 | 18,745,828 | 60.7 |

The growth in per cent. of expenses is largely due to the increase in the wage schedule and in the increased price of the material they use.

On certain classes of freight and on some parts of the system the transportation rates have been lowered, and the increased business and improved methods of operation have not been able to overcome this growing expense ratio.

The amount of traffic to be moved is steadily growing. The railways are building more feeders, enlarging their area of operation, and to keep pace with this growth and be in a position to handle quickly and safely this traffic large sums must be spent on up-keep.

## EDITORIAL NOTE.

The success that attended the agricultural motor competition at the Winnipeg Exhibition this year was so marked that it has been decided to hold a somewhat similar test in 1910. The conditions and regulations governing the same will be gone into most thoroughly by the judges who officiated at the last competition, and will be revised with the utmost caution, and many suggestions that have been made by manufacturers will be incorporated.

## CANADA'S BANKING POSITION.

**(Fred W. Field in the Monetary Times.)**

| | July, 1908. | June, 1909. | July, 1909. | Year's inc. or dec. | Month's inc. or dec. |
|---|---|---|---|---|---|
| Deposits on demand | $164,791,398 | $226,480,468 | $222,555,749 | + 35.05 | — 1.7 |
| Deposits after notice | 402,964,565 | 445,178,476 | 466,337,816 | + 15.7 | + 4.7 |
| Current loans in Canada | 525,271,185 | 535,212,269 | 539,821,041 | + 2.7 | + 0.8 |
| Current loans elsewhere | 23,153,095 | 33,403,171 | 32,753,385 | + 41.5 | — 0.1 |
| Call loans in Canada | 40,467,165 | 52,617,696 | 54,603,054 | + 34.9 | + 3.7 |
| Call loans elsewhere | 54,916,935 | 115,254,868 | 114,685,537 | + 108.8 | — 0.4 |
| Circulation | 66,697,255 | 70,170,491 | 71,006,005 | + 6.4 | + 1.1 |

The advent of the July bank statement is always awaited with considerable anxiety. The figures of our chartered banks each month are now not only followed closely by Canadian, but also by United States and British interests. The amount of foreign capital now invested in Canada has caused the Canadian monthly bank statement to become of international importance. As noted elsewhere, several hundred millions of dollars are invested in industrial and manufacturing enterprises in the Dominion, which sum is controlled by United States financiers. As to the extent to which British capital is being invested, the fact that Canada went to London in July for more than ten million pounds sterling is sufficient indication.

* * * *

At the time the Canadian banks shut down sharply on credit nearly two years ago, many complaints were heard. But a word of praise is due to the Canadian bankers for the manner in which they have assisted to bring the country back to what is now almost the normal plane of prosperity. This has been done in a remarkably short period. While much of the increased loaning power has gone into industrial expansion, the crop movement undoubtedly is claiming a large amount of money.

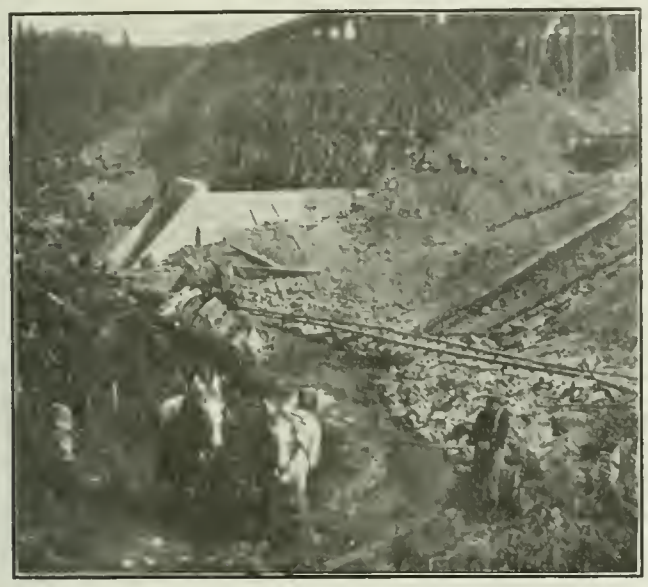
* * * *

The situation in Canada at present must strongly appeal to the man with surplus capital to invest. Not only has this country valuable and extensive natural resources, but it has proved in the past two years that it knows of an excellent way to handle a financial and commercial depression. The manner in which the Dominion stood firmly against the panic wave emanating from the United States, wrestled with its own economic problems, and brought the country back to a satisfactory position, is a record which the financial and business world may well admire.

## ROCK DRILLING CONTEST.

At a rock drilling contest at Cobalt on August 10th, a new Canadain record was established. The rock in which the drilling was done was a granite much similar to the Gunnison County granite. The winners were James Picken and Louis Page—known as the Page Bros., of Butte, Mo. They have been living at the Temiskaming mine for some time. In the fifteen minutes they drilled 43⅛ inches. Malcolm McPhail and Hector McDonald of the Gifford came next with 30⅝ inches. The Nipissing team, two Findlanders, came third with 28½ inches.

Other teams were from the Verner mine, 26⅜ inches, City of Cobalt, 24⅝ inches, Hudson's Bay, 25⅞ inches, McGuire and McMillan, 25⅝ inches, and the Otisse-Currie, 23⅜ inches.



View from Toe of Dump.

## ALBERTA'S STEAM BOILERS' ACT AMENDMENT.

In 1907 hydrostatic tests of steam boilers were required to be not less than 50 per cent. above the working steam pressure according to the type of the boiler. This provision is now repealed. The regulation as to the fire line in boilers is also changed, as is also the regulation with regard to the construction of steam domes. The section of the Act of 1906 requiring inspectors, when subjecting boilers to hydrostatic pressure to assume 110 pounds to the square inch as maximum pressure in new boilers 42 inches in diameter made of plate ¼ of an inch thick, is repealed. The provision of the old Act with reference to the working pressure is also repealed.

## OBITUARY.

MR. GEORGE A. MITCHELL, of the contracting firm of Lyall & Mitchell Company, Winnipeg, died at his home in Winnipeg on August 20th. Of late years Mr. Mitchell was one of the best known contractors and has identified himself with nearly all the larger buildings erected in Winnipeg, one of his first enterprises here being the placing of all the interior work in the City Hall. He was one of the originators of the Manitoba Construction Company, which was organized about 1903, severing his connection with that company upon its dissolution in 1905, when the firm of Kelly Bros. & Mitchell was created. He became one of the most active members of this latter firm as well as secretary of the organization. This company eventually wound up about a year ago last fall, and in the early spring Mr. Mitchell entered the firm of Lyall-Mitchell Company, which included in its membership Peter Lyall, sr., of Montreal, and Peter Lyall, jr., of Winnipeg, and George A. Mitchell. This firm is now constructing the Union Depot at Fort Garry, and has under contract the erection of the $100,000 building for the Winnipeg Rubber Company, to be erected on McDermott Street.

## MULLIN'S BROOK TRESTLE.

Six spans of one of the largest temporary trestles on the New Brunswick section of the Grand Trunk Pacific collapsed on August 14th, with the result that one workman was killed and five others had miraculous escapes from death.

The accident occurred at Mullin's Brook, four miles west of McGivney Junction, where the Grand Trunk Pacific crosses the Canadian Eastern Division of the Intercolonial.

Mullin's Brook Trestle just before the Collapse.

The trestle over Mullin's Brook comes on a curve, and is 1,100 feet long and about sixty-five feet high. The bents were of round timber, and placed at 14-foot centres. The fill contained upwards of 40,000 cubic yards of rock, and the cars filled with rock were taken out on the trestle by a small locomotive, and the rocks then dumped over the trestle.

On Saturday afternoon six of the twelve-foot spans of the wooden trestle collapsed and the donkey engine and seven four-yard cars dropped to the bottom of the gully, a distance of about fifty feet

Trestle after the Collapse, showing Donkey Engine on Dump and Track Rails Suspended.

The only reason that can be given for the collapse of the trestle is that it was put up during the winter, and a certain amount of ice and snow remained beneath the foundation, which when melting coupled with a washout as the result of the rain, caused the collapse.

This section is being built by the Toronto Construction Co.

On our page entitled "Among the Manufacturers," in last week's issue, we printed an article headed "A Kootenay Timber Yard." The illustration which accompanied the article was a view of the yards owned by The Lindsley Bros. Company of Spokane, Wash., and situated at Nakusp on the Arrow Lakes, in the Kootenay District of British Columbia. By accident, the word "Lindsley" was spelt "Lindsay."

## ELECTRIC FURNACE REDUCTION OF IRON ORE.

By Joseph W. Richards.*

In order that one can understand thoroughly the problems arising in the reduction of iron ore by carbon in an electrically heated furnace, he should first of all have a clear idea of how this reduction proceeds in an ordinary non-electrical blast furnace.

The iron ore contains iron oxide, with silica and clay as usual impurities, and more or less moisture; its phosphorous content may be low or high, but its sulphur content must be low, not over 0.5%. If the ore carries over 1% of sulphur it is given a preliminary roasting. In the furnace perhaps 99% of the iron oxide is reduced to metallic iron, 10 to 20% of the silica is reduced by carbon to silicon, which combines with the iron, all of the phosphorous is reduced into pig iron, and a varying proportion of sulphur, this proportion being smaller the more basic the slag is made with lime and the higher the running temperature.

Flux is added to make fusible slag by combining with the unreduced silica and the clay in the ore. Limestone, unburnt, is the usual flux, but magnesian limestone, carrying $MgCo_3$, is quite commonly used, the magnesia increasing the fusibility of the slag if not in greater proportion to the lime than the proportions $_2CaO.MgO$. The amount of flux added is variable; it depends on how basic the slag must be made. If the fuel is coke, and, therefore, considerable sulphur comes into the furnace, the slag formed must be nearly half lime and magnesia, to make low sulphur pig iron: if the fuel is charcoal, carrying almost no sulphur pig iron; if the fuel is charcoal, carrying almost no sulphur, and the ores carry none, the slag may be only one-third lime and magnesia and two-thirds silica and alumina, and make best quality pig iron. Such slag costs less for flux, and is more fusible than the basic lime slags.

Fuel is needed to provide heat and reducing effect. The heating effect is almost entirely produced by the combustion of the larger part of the fixed carbon (non-volatile carbon) of the fuel to carbon monoxide (CO) before the tuyeres. This combustion fills two functions: it provides the high temperature necessary to melt down the iron and slag, and it provides large quantities of reducing gas, practically indentical in composition with producer gas (30 to 35% CO, 1 to 2% H., rest $N_2$), which performs in the upper part of the furnace the larger part of the reduction.

The amount of fuel used in a blast furnace is determined by the amount which must be burned at the tuyeres to produce the necessary smelting temperature, and not by the amount necessary to perform the reduction of the metallic oxides. The amount necessary for performing the reductions taking place in the furnace is only one-third to one-half of the amount necessary to be burned to provide the smelting heat. That this statement is true of the ordinary blast furnace may be seen from the fact that if the smelting zone is increased in temperature by heating the blast, the amount of carbon used in the furnace per unit of pig iron made is at once decreased. Or, if the heat available in the smelting zone is increased by drying the blast, and thus removing the strong cooling influence which the decomposition of the moisture of the blast exerts, economy of fuel at once results. In fact, any means of getting high smelting temperature without combustion of carbon before the tuyeres decreases at once the quantity of fuel necessary to use in the furnace, since the quantity used is determined by the heat requirements in the smelting zone, and not by the requirements for reduction, which are only a fraction to the former. The ash of the fuel is largely silica, with some alumina and lime if coke, or alkalies, if it is charcoal. This requires flux to slag it, an amount which may be considerable when using poor coke high in ash. Regard for this item of cost should be had in purchasing or valuing the fuel.

The pig iron produced contains carbon between 2.5 and 4.5%, silicon in varying quantity 1 to 4%, according to the temperature and rate of running of the furnace, practically all the phosphorus of the charge, and one-tenth to one-fourth of the sulphur. Its melting point is about 1,200° C., and it runs from the furnace ordinarily at 1,500°C. to 1,600°C., carrying out as sensible heat 250 to 300 calories.

The slag may be basic or acid, as before explained, and these varieties will average in per cents.:—

| | Basic Slag. High Sulphur Charge. | Acid Slag. Low Sulphur Charge. |
|---|---|---|
| $SiO_2$ | 35 | 55 |
| $Al_2O_3$ | 10 | 10 |
| CaO | 40 | 25 |
| MgO | 10 | 5 |

These slags melt at about 1,350°C. and 1,200°C. respectively, and ordinarily run away from the furnace at 1,600°C. carrying out as sensible heat 500 calories.

The reduction of silica and phosphorus oxide in the furnace is accomplished by solid carbon in the smelting zone. A small part (10 to 20%) of the iron oxide in the furnace is also similarly reduced by fixed carbon; the rest is reduced in the upper half of the furnace by the excess of carbon monoxide gas. So much of the latter gas, however, is produced before the tuyeres in generating the temperature necessary in the smelting zone, that only a fraction of it is converted into carbon dioxide, $CO^2$, in reducing the iron oxides of the charge. This is the chief reason for the excess of unused carbon monoxide in the gases of the blast furnace, an amount whose potential calorific value often represents one-half of the calorific power of the fuel put into the furnace. It is true that all the carbon monoxide in the gases could not be utilised, no matter how small its amount, but that is a limit set by the principle of chemical equilibrium or mass action, which ordinarily is not approached because of the excessive amount of carbon monoxide produced in the lower part of the furnace in the effort to get the requisite smelting heat and temperature. The proportions of carbon ordinarily consumed at the tuyeres are 9 atoms (108 parts) of carbon for each molecule of iron oxide (160 parts) reduced by the carbon monoxide gas. The chemical equation is: $Fe_2O_3 + 9\ CO = 2\ Fe + 3\ CO_2 + 6\ CO$. This equation shows us that only one-third of the carbon monoxide produced before the tuyeres in generating the smelting temperature is utilised in reduction, while two-thirds escapes unused.

Passing to the electric principle of smelting, we have here to deal with the case of all necessary heat supplied by electrical energy, no blast blown in, and, therefore, all the solid carbon utilised for reduction (always excepting the small amount which dissolves in the pig iron) in calculating the amount of carbon necessary to thus reduce the iron oxide, we meet at the outset with this difficulty. What proportion of the carbon will form $CO^2$, and what proportion CO? We know that when reduction takes place at a very high temperature, CO is almost the only product; but as this passes more or less slowly through the cooler portions of unreduced charge, $CO^2$ is formed in increasing amounts, until at a low red heat, given sufficient time, about half the CO may be converted into $CO_2$. The formulae corresponding to these two extremes are:

$Fe_2O_3 + 3C = Fe_2 + 3CO$.

$Fe_2O_3 + 2C = Fe_2 + CO + CO_2$.

Comparing these with the ordinary blast-furnace reaction, which requires 9 C put into the furnace for the reduction of Fe, we see that 3 C, or one-third as much carbon, is the greatest amount necessary in the electric furnace reduction and 2C, or between one-third and one-fifth as much, is the smallest amount necessary. As will be further shown, the uncertainty as to how much $CO_2$ can be formed in the electric furnace reduction is perhaps the chief difficulty in running the electric furnace.

*Paper read before the American Electrochemical Society, Niagara Falls.

Example.—Iron ore is to be reduced to pig iron in an electric furnace, and the flux and charcoal on hand for the charge analyze as follows:—

| Iron Ore. | | Limestone. | | Charcoal. | |
|---|---|---|---|---|---|
| $Fe_2O_3$ ..... | 90 | $CaCO_3$ ..... | 90 | Fixed C.... | 90 |
| $SiO_2$ ..... | 8 | $MgCO_3$ ..... | 3 | Volat'e Mt'r. | 6 |
| $Al_2O_3$ ..... | 2 | $SiO_2$ ..... | 2 | $SiO_2$ ..... | 2 |
| | | | | $Al_2O_3$..... | 1 |
| | | | | $K_2O$, $Na_2O$.. | 1 |

Assume the pig iron made will contain 4% of carbon and 3% of silicon; that the slag may be 65% ($SiO_2 + Al_2O_3$); that the gases contain only the $CO_2$ from the limestone, and none from the reductions.

Required: (1) The weights of ore, limestone, and charcoal to charge per 100 of pig iron made; (2) the percentage composition of the gases; (3) the weight and percentage composition of the slag.

Solution: (1) The weight of ore needed is that necessary to supply the 93 parts (100 — 4 — 3) of iron in the pig iron. This will require 133 parts of $Fe_2O_3$, which will be contained in 133 ÷ 0.90 = 148 parts of ore.

The weight of charcoal needed is that necessary to furnish enough fixed carbon to reduce the iron oxide and that silica which is reduced, and to supply the carbon in the pig iron. These quantities are:—

| | |
|---|---|
| Reduction of $Fe_2O_3$: .. .. | 93 × 36/112 = 29.9 |
| Reduction of $SiO_2$: .. .. | 3 × 24/28 = 2.6 |
| For carbon dissolved .. .. .. .. | = 4.0 |
| Total requirement .. .. .. .. | = 36.5 |
| Charcoal required 36.5/0.90 .. .. .. | = 40.6 |

The weight of flux required is best found by calling it x, and then figuring out the slag, as follows:—

Silica in the slag will be that in the ore, flux, and fuel, minus that reduced to silicon. Therefore,

| | | |
|---|---|---|
| In ore ..... | 148 × 0.08 = | 11.8 |
| In flux ..... | x × 0.02 = | 0.02 x |
| In fuel ..... | 40.6 × 0.02 = | 0.8 |
| Reduced ..... | 3 × 60/28 = | 6.4 |
| Silica in slag ..... | = | 6.2 + 0.02 x |

By similar calculations we find the slag to contain, as a whole:—

| | |
|---|---|
| Silica ..... | 6.2 + 0.02 x |
| Alumina ..... | 3.4 |
| Lime ..... | 0.50 x |
| Magnesia ..... | 0.04 x |
| Alkalies ..... | 0.4 |
| Total weight ..... | 10.2 + 0.56 x |

If the slag is to be 65% of silica and alumina together, then

$$0.65\ (10.0 + 0.56x) = 9.6 + 0.2x$$

from which $x = 9$.

The above solution is perfectly general, and applies to all kinds of ore, flux, and fuel, and the production of any desired kind of slag.

(2) The gases will contain the fixed carbon of the charcoal (except that part that goes into the pig iron) in the state of CO, the carbonic acid driven off the flux, and the volatile matter from the charcoal. The latter may be assumed as composed of equal parts by volume of hydrogen, carbon monoxide, and carbon dioxide, which would correspond to weights of those gases in the proportion of 2:28:44. The gases passing off will therefore be, in parts by weight:

| | | |
|---|---|---|
| CO from fixed carbon .... | 32.5 × 28/12 = 75.8 | |
| CO from volatile matter. | 2.7 × 28/74 = 1.0 | 76.8 |
| $CO_2$ from volatile matter | 2.7 × 44/74 = 1.6 | |
| $CO_2$ from flux ..... | 9.0 × 0.44 = 4.0 | |
| $H_2$ from volatile matter.... | 2.7 × 2/74 = 0.1 — | 0.1 |
| Total weight of gases ..... | | 82.5 |

Percentage composition of gases by volume:—

| | | Per cent. | |
|---|---|---|---|
| CO .. .. .. .. | 76.8÷126 = | 6.10 | 92.4 |
| $CO_2$ .. .. .. | 5.6÷1.98 = | 2.8 | 4.2 |
| $H_2$ .. .. .. .. | 0.1÷0.09 = | 2.2 | 3.4 |
| | | 6.60 | 100.0 |

The volumes 61.0, 2.8, and 2.2 represent cubic meters of these gases per 100 kgs. of pig iron made; if multiplied by 16 they give the cubic feet per 100 lbs. of pig iron.

(3) The slag will contain, substituting x × 9:

| | Per cent. | |
|---|---|---|
| Silica .. .. .. | 6.4 = | 42.4 |
| Alumina .. .. .. | 3.4 = | 22.5 |
| Lime .. .. .. | 4.5 = | 29.8 |
| Magnesia .. .. .. | 0.4 = | 2.65 |
| Alkalies .. .. .. | 0.4 = | 2.65 |
| | 15.1 | 100.00 |

Combined Blast and Electrical Furnace.—The electrical reduction of iron ore differs radically from blast-furnace practice in one essential particular, viz., that since no air is blown in, any excess of carbon above that consumed in reduction must remain unused, accumulate, and eventually clog the furnace. The amount to be used as a minimum cannot, moreover, be calculated until we know how much $Co_2$ will be formed in reduction, and that is an unknown quantity unless arrangements are made so that none can be formed. The following modifications of working an electrical pig-iron furnace are possible, with the object in view of avoiding the accumulation of excess carbon in the crucible:—

(1) A deficit of carbon may be put into the charge, thus permitting unreduced iron oxide to escape in the slag, and preventing unused carbon from accumulating. This solution leads to the disadvantages of loss of iron, heavy corrosion of lining of furnace, and heavy consumption of electrode carbon. It may have the secondary result of preventing reduction of silica or taking up of carbon by the iron, and thus furnish a metal with high melting point and approaching steel in composition. Such slag would also remove some of the phosphorous in the charge, but practically no sulphur.

(2) A charge of ore and flux without fuel may be run through the furnace whenever an accumulation of carbon occurs, as is shown by the resistance of the furnace falling off and the furnace getting cold. This was the device adopted in the experiments of the Canadian commission at Sault Ste. Marie, but while permissable in experimental work, it would not do to thus periodically derange a furnace in regular running.

**Charge Sheet—per 100 of Pig Iron Produced.**

| Charges. | Pig Iron. | Slag. | Gases. |
|---|---|---|---|
| Ore: (148.0) | | | |
| $Fe_2O_3$ ..133.2 | Fe .....93.0 | | O.....40.2 |
| $SiO_2$ ... 11.8 | Si ..... 3.0 | $SiO_2$.... 5.4 | O..... 3.4 |
| $Al_2O_3$ .. 3.0 | | $Al_2O_3$.... 3.0 | |
| Limestone: (9.0) | | | |
| CaO ... 4.5 | | CaO.... 4.5 | |
| MgO ... 0.4 | | MgO ... 4.5 | |
| $SiO_2$ ... 0.2 | | $SiO_2$.... 0.2 | |
| $CO_2$ .... 4.0 | | | $Co_2$.. .. 4.0 |
| Charcoal: (4.06) | C ..... 4.0 | | |
| Fx'd C .. 36.5 | | | C.....32.5 |
| CO ..... 1.0 | | | CO..... 1.0 |
| $CO_2$ ..... 1.6 | | | $CO_2$.... 1.6 |
| $H_2$ ..... 0.1 | | | $H_2$..... 0.1 |
| $SiO_2$ .... 0.8 | | $SiO_2$.... 0.8 | |
| $Al_2O_3$ ... 0.4 | | $Al_2O_3$ ... 0.4 | |
| $(NaK)_2O$ . 0.4 | | $(NaK)_2O$ . 0.4 | |
| Totals ....197.9 | 100.0 | 15.1 | 82.8 |

(3) The fuel may be calculated only for the production of CO in the furnace, and this condition approximated by

leading off the gases from the hot part of the furnace and not allowing them to cool in contract with the ore. In this way reduction by CO is avoided, and the fixed carbon in the charge may be consumed almost entirely to CO without formation of$CO_2$. This would bring the furnace consumption of carbon nearer to a definite amount, and by avoiding reduction except by solid carbon tend to use up all the carbon charged, the amount of which would be calculated by this manner of working (as in the numerical example worked out for illustration).

(4) The best solution of this difficulty may be to provide tuyeres by which air can be sent into the crucible of the furnace, and thus burn any accumulation of carbon. A given quantity of air will always burn a given quantity of carbon, and therefore the cure would seem to lie in having a variable supply of air, which is increased whenever the falling resistance of the furnace indicates that carbon is beginning to accumulate, and diminished to a small minimum supply, only enough to keep the tuyeres open, when the furnace is in good electrical running order. It would represent a combined electrical and blast furnace, with the blast so regulated as to overcome the chief difficulty of the purely electrical furnace—the accumulation of unused carbon in the crucible.

It may be quite possible, by some such device as Mr. Taylor's large electrical furnace, to practically combine the blast furnace and the electrical furnace. The writer is quite confident that any practical method of introducing electrical heat into the crucible of a blast furnace will result in large economies in the furnace working. Only one-quarter of the heating power of the fuel is developed around the blast tuyeres, and yet if half of this could be replaced by electrically-generated heat, an economy of 50% could in all probability be reached upon the fuel bill. To put it into figures, it takes 1.2 tons of coke to make a ton of pig iron in the blast furnace, and about three-quarters of a ton is burnt by the blast, producing at the smelting zone about 25% of the calorific power of the coke. If electrical energy could be made to supply one-half of this, the furnace would make iron with half the previous coke supply, that is, with 0.6 ton of coke per ton of pig iron, and this with an expenditure of electrical energy equal to 12.5 per cent. of the calorific power of but 0.15 tons of coke.

The question of economy in this case will not be, then, the simple replacement of fuel heat energy by an equivalent amount of electrical heat energy, but the comparison of fuel heat energy with the cost of one-fourth its amount of electrical heat energy. This may be quite possible in many localities, and the combined furnace would work more regularly than a purely electrical furnace. The question awaits the coming of the electro-metallurgical engineer who can make practicable the requisite combination. A possible solution may be to use cheap electrical power to superheat the hot blast, and thus to make the blast itself the agent for carrying electrically developed heat into the furnace.

## CEMENT—CONCRETE.

**Quebec.**

MONTREAL.—V. T. Chapnon has secured a contract for cementing the wading pool in Lafontaine Park, at $1,975.

**British Columbia.**

VANCOUVER.—After calling for tenders for five miles of concrete walks the city has decided to do the work by day labor. Two firms bid 14c a square foot.

**Ontario.**

OTTAWA.—A merger of Canadian cement companies has been affected. The capital is $30,000,000. Sir Sanford Fleming is president, and ten cement plants in this country are involved. It is reported that negotiations have been completed for the purchase of the following companies, except, possibly the Belleville plant of the Lehigh Company, with which a contract has not yet been completed. The Vulcan Portland Cement Company, Limited, of Montreal. The Lehigh Portland Cement Company, Limited, of Belleville, Ontario. The Belleville Portland Cement Company, Limited, Belleville, Ontario. The Canadian Portland Cement Co., Ltd., with properties at Marlbank and Port Colborne, Ontario. The International Portland Cement Co., Ltd., of Hull or Ottawa. The Western Canada Portland Cement Co., Ltd., with properties at Exshaw, Alberta. The Lakefield Portland Cement Co., of Montreal. The Lakefield Portland Cement Co., Ltd., of Lakefield, Ontario. The Owen Sound, Portland Cement Company, Limited, of Owen Sound, Ontario. The Alberta Portland Cement Co., Ltd., of Calgary, Alberta. The new company also proposes to construct plants immediately at Winnipeg and Victoria, B.C., where large deposits of suitable material have been discovered. As far as can be learned, the authorized and issued capital of the merger will be as follows:—

| | Authorized | To be issued |
|---|---|---|
| Bonds | $ 8,000,000 | $ 5,000,000 |
| Preferred | 11,000,000 | 9,000,000 |
| Common | 19,000,000 | 12,500,000 |
| Total | $38,000,000 | $26,500,000 |

Of the $9,000,000 preferred, $4,000,000 will go to pay for properties, so that only $5,000,000 will be issued to the public. A strong group of both Canadian and English financiers are already identified with the project. The provisional directors are: Sir S. Fleming, W. M. Aitkin, Hon. W. Edwards, J. S. Irvin, Hon. R. Mackay, R. Forget, M.P., J. R. Booth, F. B. Dunsford. The Bank of Montreal will be the bankers for the new company, and the Royal Trust Company will act as trustees for the bondholders.

PRESCOTT.—Last week's issue of the Canada Gazette contains notice of the incorporation of the Canadian Cement Casket Co., with a capital of $99,950. Mr. H. E. Whitney, of Prescott, is a director.

PETERBOROUGH.—E. A. Hay, city engineer, invites tenders for the erection of a reinforced concrete bridge over the River Otonabee.

(Continued from page 231).

| | | | |
|---|---|---|---|
| Small factories or steam engines | 5 | to | 25.00 |
| Restaurants, club and pool-rooms | 4 | to | 20.00 |
| Taverns | 10 | to | 25.00 |
| Wholesale liquor stores (unmetered) | 25 | to | 50.00 |
| Light wagon horses, including water for washing carriage, each | | | 2.00 |
| Omnibus, coach or truck horses, each | | | 1.00 |
| Cows, each | | | 1.00 |
| Stalls, each | | | 0.50 |
| Hand hose (jet not to exceed ¾ inch) to be used before 9 a.m. and after 5 p.m. | | | 0.50 |
| Soda fountains | | | 3.00 |
| Photograph studios | $5 | to | 10.00 |
| Drug stores | 3 | to | 10.00 |
| Laundries not using steam power | 5 | to | 10.00 |
| Other places where water is used from 50 cents upwards. | | | |
| Water supplied for building purposes: | | | |
| Ordinary frame house | | | 2.00 |
| Large frame house | | | 3.00 |
| Ordinary brick house | | | 5.00 |

Larger buildings by meter at the rate of five dollars for fifty thousand gallons, or less, and one cent per one hundred gallons for any quantity over fifty thousand gallons, the meter to be placed to the satisfaction of the Board at the expense of the applicant.

Repairing and re-modelling buildings.

Each barrel of lime or cement ..... .05

But no charge less than one dollar.

## WATER RATES OF THE CITY OF WINNIPEG, MAN.

| Number of Rooms | Consolidated Rate, including extras per quarter |
|---|---|
| 4 or less | $1.50 |
| 5 | 1.80 |
| 6 | 2.10 |
| 7 | 2.40 |
| 8 | 2.70 |
| 9 | 3.00 |
| 10 | 3.30 |
| 11 | 3.60 |
| 12 | 3.90 |
| 13 | 4.20 |
| 14 | 4.50 |
| 15 | 4.80 |
| 16 | 5.10 |

Over 16 rooms 30c. a room per quarter.

The consolidated rate includes all fixtures. No fixture shall be used unless it has been first approved of by the city.

Allowance: Consolidated rate, 20 gallons per room per day.

Special Rates: For brick work, 5c. per 1,000 brick.

For plastering, 25c. per 100 square yards.

For concrete work, 5c. per cubic yard.

For stone work, 5c. per cord.

Water, according to meter rate, 20c. per 1,000 gallons, subject to discount as follows:

A single consumer using in respect of any one building 200,000 gallons and less than 400,000 per quarter, is entitled to a discount of 5 per cent.

A single consumer using in respect of any one building 400,000 gallons and less than 600,000 per quarter is entitled to a discount of 10 per cent.

A single consumer using in respect of any one building 600,000 gallons and less than 800,000 gallons per quarter, is entitled to a discount of 15 per cent.

A single consumer using in respect of any one building 800,000 gallons or upwards per quarter, is entitled to a discount of 20 per cent.

In no case, however, shall the amount charged be higher than the minimum paid by consumers in the next highest class.

These discounts are in addition to the regular 5 per cent. discount allowed for prompt payment.

## WATER RATES OF THE CITY OF ST. JOHN, N.B.

### Schedule C.

| | |
|---|---|
| One family | $ 3.00 |
| Each additional family in the same house | 3.00 |
| One water closet with cistern and self-closing flush | 4.00 |
| Each additional water closet with cistern and self-closing flush in same house | 4.00 |
| One water closet without cistern and self-closing flush | 6.00 |
| Each additional water closet without cistern and self-losing flush in same house | 6.00 |
| Baths, each | 3.00 |
| Urinals, each | 3.00 |
| Set wash bowls with taps attached, each | 0.50 |
| Boarding houses, not less than | 4.00 |
| General stores and shops, from $2 to | 50.00 |
| Small shops in remote districts, not to exceed | 1.00 |
| Offices | 3.00 |
| Barber shops, one chair | 2.00 |
| Barber shops, each additional chair | 2.00 |
| Blacksmith shops, one fire | 2.00 |
| Blacksmith shops, each additional fire | 1.00 |
| Other workshops, from $2 to | 10.00 |

(Continued on previous page.)

## WATER RATES OF THE CITY OF MONCTON, N.B.

| | |
|---|---|
| ¾ inch service, one family now in use | $ 8.00 |
| 1 inch service, one family rate | 10.00 |
| 5/8 inch service, one family rate | 12.00 |
| And for each additional family supplied from one service | 4.00 |
| Water closets, fed by tanks | 3.00 |
| Water closets, fed direct from pipe | 7.00 |
| Bath tub | 2.00 |
| Urinal, approved style | 2.00 |
| Horse and carriage, with hose | 3.00 |
| Each additional horse | 2.00 |
| Cows, each | 1.00 |
| Hose for lawns and watering pavement, etc | 3.00 |

### Livery Stables.

| | |
|---|---|
| ½ inch service | $10.00 |
| 5/8 inch service | 12.00 |

In addition to service, $2.00 per stall or 25 cents per 1,000 gallons, at option of the City Council.

### Hotels.

25 cents per 1,000 gallons, or by special agreement with the City Council.

### Engines and Boilers.

$5.00 for horse power per year, not exceeding 12 hours per day, metered at 25 cents per 1,000 gallons, at option of City Council.

### Building Purposes.

| | Per 100 cubic feet. |
|---|---|
| Bricks, per 1000 | .10 |
| Stone, per cubic yard | .05 |
| Plastering, per 100 yards superficial | .40 |

Manufacturing and other purposes, by special agreement with the Council.

For purposes not named in Schedule, and for peculiar circumstances, contracts will be made by the City Council.

## WATER RATES OF THE CITY OF VANCOUVER, B.C.

The Vancouver City Water Works reserve the right, at their pleasure, to substitute in lieu of the above rates the rate of 16 cents per 100 feet.

### Meter Rates.

| | Cents per 100 cubic feet. |
|---|---|
| 500 to 5,000 | 16 |
| 5,000 to 10,000 | 15 |
| 10,000 to 20,000 | 14 |
| 20,000 to 30,000 | 13 |
| 30,000 to 40,000 | 12 |
| 40,000 to 50,000 | 11 |
| 50,000 to 60,000 | 10 |
| 60,000 to 70,000 | 9 |
| 70,000 to 80,000 | 8 |
| Over 80,000 | 7 |

### Manufacturers' Rate.

| | Cents per 100 cubic feet. |
|---|---|
| Up to and including 50,000 cubic feet | 10 |
| 50,000 to 75,000 cubic feet | 8 |
| Over 75,000 cubic feet | 7 |

A discount of 20 per cent. if paid within 20 days.

### Meter Rent.

| | | |
|---|---|---|
| 5-8 inch meter | 25 cents | per month |
| 3-4 " | 50 " | " |
| 1 " | 75 " | " |
| 2 " | $1.50 | " |
| 3 " | 2.00 | " |
| 4 " | 2.50 | " |
| 6 " | 3.00 | " |

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Aug. 21 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Aug. 20 '08 | Price Aug. 13 '09 | Price Aug. 20 '09 | Sales Week End'd Aug20 | Price Aug. 20 '08 | Price Aug. 13 '09 | Price Aug. 20 '09 | Sales Week End'd Aug20 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,555,000 | 1,336,000 | 172½ | 188 187½ | 184½ | 289 | 178 172⅝ | 187⅜ 187½ | 125½ 185 | 586 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 175,100 | 162,500 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 857,003 | 798,254 | ..... | ... *1st. pref. 106, 3rd pref. 58½, ordinary 24½ | | ..... | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Rnad) | ..... | 33,839 | 18,411 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 76,463 | 71,550 | ..... | ..... | ..... | ..... | 177½ 177 | 215½ 214½ | 213½ 212½ | 235 |
| Toronto Street Railway | 114 | 8,000 | 100 | 72,251 | 66,228 | 106½ | 126½ 126 | 125¼ 125 | 10 | 106 105 | 126 125¼ | 125 123½ | 202 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 163 161½ | ..... | 190 188 | 158 | ..... | ..... | 187½ 186½ | ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILWAY EARNINGS.

The gross earnings of all United States roads reporting for the first two weeks in August amount to $10,834,463, a gain of 12.4 per cent. over the same period last year, and 8.9 per cent. as compared with 1907. Railroad earnings continue to exhibit most satisfactory increases and for the month promise to approximate the record year 1907. In the following tables is given earnings of United States roads so far reporting for the first two weeks of August and the same roads for July; also the more complete reports for July and the two preceding months:

| | Gross Earnings 1909 | Gain | Per Cent. |
|---|---|---|---|
| August—two weeks | $10,834,463 | $1,202,013 | 12.4 |
| July—two weeks | 10,613,005 | 498,463 | 4.9 |
| July | 44,198,684 | 3,503,660 | 8.6 |
| June | 45,538,286 | 4,223,790 | 10.2 |
| May | 44,591,299 | 5,599,683 | 14.5 |

One more road, the Baltimore and Ohio, the only one of the Eastern Trunk lines, has reported for July, and it shows a very large gain over last year, although there is still a loss of 4.0 per cent. as compared with 1907. Total gross earnings of all United States roads so far reporting for July amount to $44,198,684, a gain of 8.6 per cent. over the same period last year, but there is still a loss compared with 1907. All classes of roads help to swell this large increase over last year, and the gains are especially large on Eastern Trunk, Other Eastern and South-Western. The statement follows:

| July | Gross Earnings 1909 | Gain | Per Cent. |
|---|---|---|---|
| Trunk Eastern | $ 6,950,872 | $1,228,767 | 21.4 |
| Trunk Western | 5,707,005 | 308,014 | 5.7 |
| Other Eastern | 823,510 | 150,881 | 22.1 |
| Central Western | 6,264,183 | 294,905 | 4.9 |
| Granger | 1,711,950 | 133,151 | 8.4 |
| Southern | 13,324,467 | 586,344 | 4.8 |
| South-Western | 9,416,697 | 800,698 | 9.3 |
| United States roads | $44,198,684 | $3,503,660 | 8.6 |
| Canadian | 7,004,000 | 808,000 | 13.0 |
| Mexican | 4,422,621 | 209,000 | 4.9 |
| Total | $55,625,305 | $4,520,660 | 8.8 |

## CANADIAN NORTHERN RAILWAY.

Earnings and operating expenses for July:

| | 1909 | 1908 | Increase |
|---|---|---|---|
| Gross earnings | $843,500 | $728,500 | $115,000 |
| Expenses | 613,000 | 525,600 | 88,300 |
| Net earnings | 229,600 | 202,900 | 26,700 |
| Mileage in operation | 3,094 | 2,874 | 220 |

Statistics just issued by the Board of Trade in London, Eng., show that not a single passenger in the United Kingdom lost his life in a train wreck during the year 1908, though many persons were killed by railway trains in various other ways, such as crossing the tracks, trespassing, etc.

## GRAND TRUNK SYSTEM.

The Grand Trunk Railway reports as follows for the six months ended June 30 last:—

| | 1909 | 1908 | Changes Increase |
|---|---|---|---|
| Gross earnings | £2,866,400 | £2,919,200 | *£52,800 |
| Operating expenses | 2,079,200 | 2,137,300 | 58,100 |
| Net earnings | £ 787,200 | £ 781,900 | £ 5,300 |
| Other income | 58,100 | ..... | 58,100 |
| Total income | £ 845,300 | £ 781,900 | £63,400 |
| Charges | 498,600 | 485,900 | 12,700 |
| Balance | £ 346,700 | £ 296,000 | £50,700 |
| Can. Alt. def. | 41,100 | 68,900 | *27,800 |
| Det. Gd. Hav. def. | 25,700 | 46,600 | *20,900 |
| Surplus | £ 279,900 | £ 180,500 | £99,400 |

* Decrease

## SITTINGS OF THE DOMINION RAILWAY BOARD.

It is the intention of the Railway Commission to make a trip to the Pacific coast. Sittings will be held as follows: Winnipeg October 11; Brandon, October 13; Regina, October 14; Saskatoon, October 15; Prince Albert, October 16; Edmonton, October 20; Calgary, October 22; Vancouver, October 27; Victoria, October 29, and at Nelson and Lethbridge at later dates. Assistant Chairman Scott will preside at the sittings.

The annual meeting of the Grand Trunk Pacific Railway will be held in Montreal on September 21, and that of the Grand Trunk Pacific branch lines company on the 15th of September.

The earnings of the Grand Trunk Railway for the six months ended June 30 show good advances. The net clearings show an increase of $26,500, and the surplus now amounts to $497,000. The expenses have been reduced considerably and general improvement is shown.

## PERSONAL.

MR. J. M. CAMERON, formerly C.P.R trainmaster at Grand Forks, succeeds Mr. S. L. Prenter as trainmaster at Vancouver.

MR. G. H. BRYSON, formerly of Ottawa, and recently city engineer of Nanaimo, B.C., has been appointed assistant to City Engineer Topp of Victoria, B.C.

MR. ROBERT REID, of Ottawa, a member of the National Transcontinental Railway Commission of Canada, died suddenly on August 22nd at the Sparhawk Hotel, in Ogunquit, Maine. He was born in London, Ont., 53 years ago, and had lived there previous to his residence in Ottawa. On the establishment of the National Transcontinental Board in 1904, Mr. Reid was one of the first chosen to act on it, his appointment dating from September 1, 1904. He had held office continuously since that time. He was an Anglican in religion and was a member of both the Rideau and the Country Clubs, having resided in Ottawa for the last five years.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## LINDSAY OZONIZATION AND THE ONTARIO PROVINCIAL BOARD OF HEALTH.

A few weeks ago we had occasion to make some remarks upon the ozonized water at Lindsay. The criticism was confined to an examination of an analysis made by Dr. Archibald, of Toronto University. The deductions made were: (a) That the analysis showed that ozone removed less bacteria than the rough filters by which the water was primarily treated. (b) That the total number of bacteria removed by the joint process of both rough filtration and ozone was below the standard required of ordinary mechanical filters. The above deductions were simply matters of fact apparent at once upon an examination of the analysis.

The local Lindsay newspapers, however, made other deductions and came to different conclusions. In fact, they went into hysterics over the wonderful work and efficiency of the plant. It was stated that mose impure water was rendered pure by ozone to a degree never rendered by any other method. These conclusions have been advertised by other papers, with the result that an altogether false impression has got abroad with reference to this, the first instalment of ozone water purification in Canada.

The town council of Lindsay, we consider, are much to blame in the matter. Instead of waiting until the supreme authority of Ontario, viz., the Provincial Board of Health, has given its verdict on the plant, they adopted the plant as satisfactory on the strength of Dr. Archibald's analysis, which he, himself, admits as being practically useless as a measure of the efficiency of the ozone, there being so small a degree of biological contamination in the raw water to commence with.

For some reason or another a report has been circulated that the Provincial Board of Health has shown no anxiety to test or examine the Lindsay plant; in fact, have looked askance upon the whole venture. It is a fact that up to the present the Board of Health has not made any final or conclusive test, nor has it pronounced any verdict upon the process. Apart from the above report, however, we find that another has also got abroad, viz., that the Provincial Board of Health has accepted the process as satisfactory. This is no doubt due to a false understanding that Dr. Archibald has some connection with the Board. Dr. Archibald's tests, analysis, and reports are entirely in a private capacity, and are not recognized by the Board.

As to the question of any apathy on the part of the Provincial Board, we find, on enquiry, that the facts prove the reverse. It, as a body, is anxious and ready at the present time to make a thorough and complete examination and report, but is only stopped from so doing by those responsible for the plant, as they claim that certain alterations and additions have yet to be made to complete the work. It is expected that these alterations, etc., will be completed about the 10th of September. As soon as the plant is in a complete state, and ready to the satisfaction of those responsible for the process, the Board will make a thorough and extended examination, taking samples for analysis from day to day, in order to show the efficiency of the preliminary filtration and the amount of purification effected by the ozone contact.

There exists neither in this journal nor in the mind of the Provincial Board of Health any prejudice in the matter. Ozone treatment of water is no new experiment; it is new, however, in Canada. There exists no definite data anywhere as to the practical efficiency of ozone as a sterilizing agent in practice, although many laboratory experimental results have been published. Unfortunately, laboratory experiments have a tendency to give efficiencies which are not always obtained in practice. It is, therefore, natural that we keep an open mind until some real working data based on conclusive tests are made. We have said that the council are much to blame, in that conclusive deductions were published before the works received the Board's sanction. As a matter of fact, the Lindsay council at the very commencement of the work ignored Section 30 of the Public Health Act, and never submitted plans or gave notice of their scheme to the Board of Health. It was not until Dr. Amyot was communicated with on May 3rd, 1909, that the Board had any knowledge that such work was in progress. Dr. Hodgetts (Secretary to the Provincial Board of Health) at once called the attention of the Lindsay authorities to this section of the Act, and on May 13th Lindsay supplied the Board with particulars and copy of contract with the company responsible for the installation.

On June 1st, the earliest date possible, a meeting of the Provincial Board of Health was held, it was decided that the chairman (Dr. Sheard) and secretary (Dr. Hodgetts) should inspect the plant and decide what tests and examination were necessary.

On June 7th, the Provincial Board received a letter from the contractors, asking that the visit be deferred, as some improvements to the works were yet necessary.

On June 26th, the contractors asked that an appointment be made for the above inspection. Dr. Hodgetts replied that he would arrange with Dr. Sheard to make the inspection at an early date, Dr. Sheard being at that time on a vacation. In the meantime the Lindsay authorities asked for sterilized bottles in order to convey samples of the water to Dr. Amyot for analysis. Dr. Hodgetts replied on June 30th that no analysis or test should be made until the Board had made its inspection and arrange for such. The inspection was delayed, owing to Dr. Hodgetts having to visit the West on or about the return of Dr. Sheard to Toronto. Lindsay then determined to ignore the Provincial Board of Health for a second time, and called in a private chemist, who produced the analysis on which we have formerly commented, and which, as far as the efficiency of the plant is concerned, is of no value.

On July 20th, the Provincial Board of Health "en masse" made a visit to the Lindsay plant, and at the request of the mayor undertook to at once make a complete test and examination of the whole plant. Dr. Amyott and Dr. Nasmith visited the works to make the arrangements, and were informed by the contractors that such could not be made until the 10th of September as the works required further alterations and additions to complete them.

Authorities in Ontario should learn that the Provincial Board of Health exists for their benefit, and if duly and properly consulted can give good and sound advice. It does not exist, however, for the purpose of bolstering up any fad, or providing a pull on behalf of any company or patent vendors. Dr. Sheard (the chairman) is not handling his own funds, and is, therefore, not likely to advise or agree with experimental work carried out with other people's money, and when he, through his Board, gives advice, it is natural that he insists that such advice is based on known and proven data. We cannot expect him to form opinions and to advise his Board to come to any conclusion on this Lindsay plant until these requisite data are before him.

The value of a central health authority to Ontario is great in checking what may be useless expenditure and insisting upon efficiency; but that value depends, in its practical application, upon the confidence and willingness of local authorities to act in unison with that central authority, and not attempt either through ignorance or carelessness to ignore the authority as Lindsay has evidently done in this case.

[Proofs of the above article were submitted to the chairman of the Provincial Board of Health, who stated that this article fairly and accurately represents the facts of the case, and suggested no alterations to the original proof.—Ed. San. Rev.]

## MECHANICAL FILTERS.

So many enquiries have of late been sent in relative to mechanical filtration as applied to water supplies that we consider a few remarks embracing such enquiries will best meet the occasion.

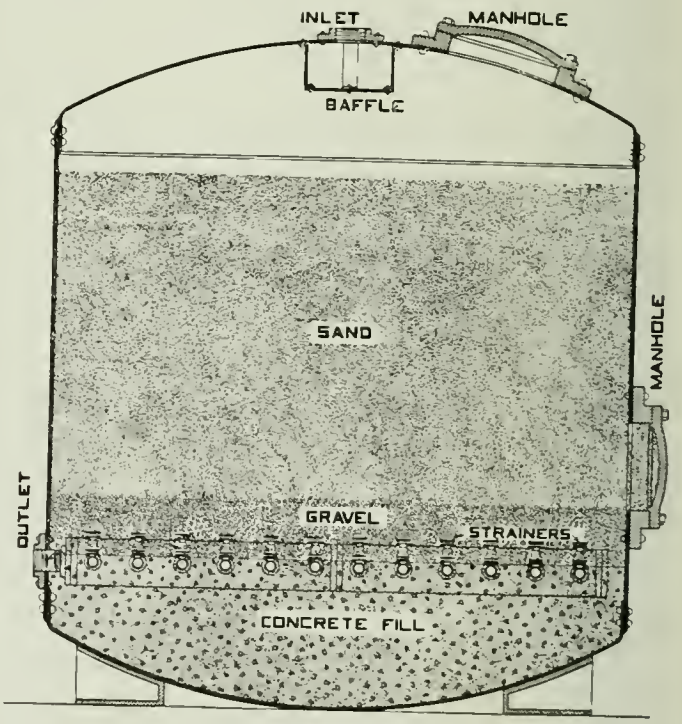
Mechanical filtration of water is not a perfect process, neither is slow sand filtration, and up to the present all methods of sterilization in practice also show certain degrees of imperfection. There are many who are content to judge of an apparatus or process entirely from its inefficiency standpoint without giving due consideration to its efficiency, and comparing reasonably the degree of efficiency of any particular process with others. We find such people in everyday life taking this standpoint relative to ordinary things. For instance, the man who could easily afford a motor car, and who would enjoy the use of one, is content to do without, because he thinks that the motor car may yet arrive at a greater degree of perfection. As absolute perfection, in human contrivances, is unobtainable; such a man goes through life without ever enjoying the leading products of his age.

How often we find the statement made: "Filtration of water is all very well if properly attended to, but it requires care and nursing in order to obtain satisfactory results." Is there any machine or mechanical structure which will give its maximum efficiency if not properly attended to? Why judge of the efficiency of a machine when it is the efficiency of attention which is at fault?

Slow sand filtration in the past has not been the success in America which it has in the countries of Europe. This is not the fault of slow sand filtration; it is entirely the fault of those in charge of the works. Mechanical filtration may be said to be more purely American in its use. It was first used in connection with paper mills to remove the larger particles of matter from the great quantities of water used. At first these filters were simply constructed of wood in the form of cylinders filled with sand and gravel, filtering at the rate of from one to two million gallons per acre per day. Great improvements, however, have been made in their construction; and, with additional precipitation, by aid of coagulants, they have been operated for municipal supplies with most satisfactory results. The 1908 annual report for the city of Harrisburg, Pa., shows efficiencies of 99.62 per cent. for bacterial removal, this being the average for the whole year. The above result is not unusual, as the writer is acquainted with a number of plants giving average efficiencies of 99.5 per cent. and 99.75 per cent. It is the custom, however, and we ourselves must confess to be guilty, of referring more generally to plants which by no means attain such high efficiencies. Criticism, as a rule, is directed at defects, but in dealing with the question generally, it is fair to point our really what can be done, and is done, with proper attention. In all cases of failure the cause can generally be detected, and is invariably found to exist apart from any inherent defect in the filter. Causes of failure are frequently found in inattention to cleaning, improper use of coagulant, the omitting of any coagulant when such is necessary, too great a rate of filtration for the filter capacity, etc.

The Imperial Board of Health of Germany in 1894 drew up articles relative to filtration of surface water for the direction of public supplies. Two of these articles are as follows:—

(a) "The operation of a filter is to be regarded as satisfactory when the filtrate contains the smallest possible number of bacteria, not exceeding the number which practical experience has shown to be attainable with good filtration at the works in question. In those cases where there are no previous records showing the possibilities of the works and the influence of the local conditions, especially the character of the raw water, and until such information




SECTIONAL VIEW OF FILTERS, STYLE "L"

is obtained, it is to be taken as the rule that a satisfactory filtration will never yield an effluent with more than about 100 bacteria per cubic centimeter.

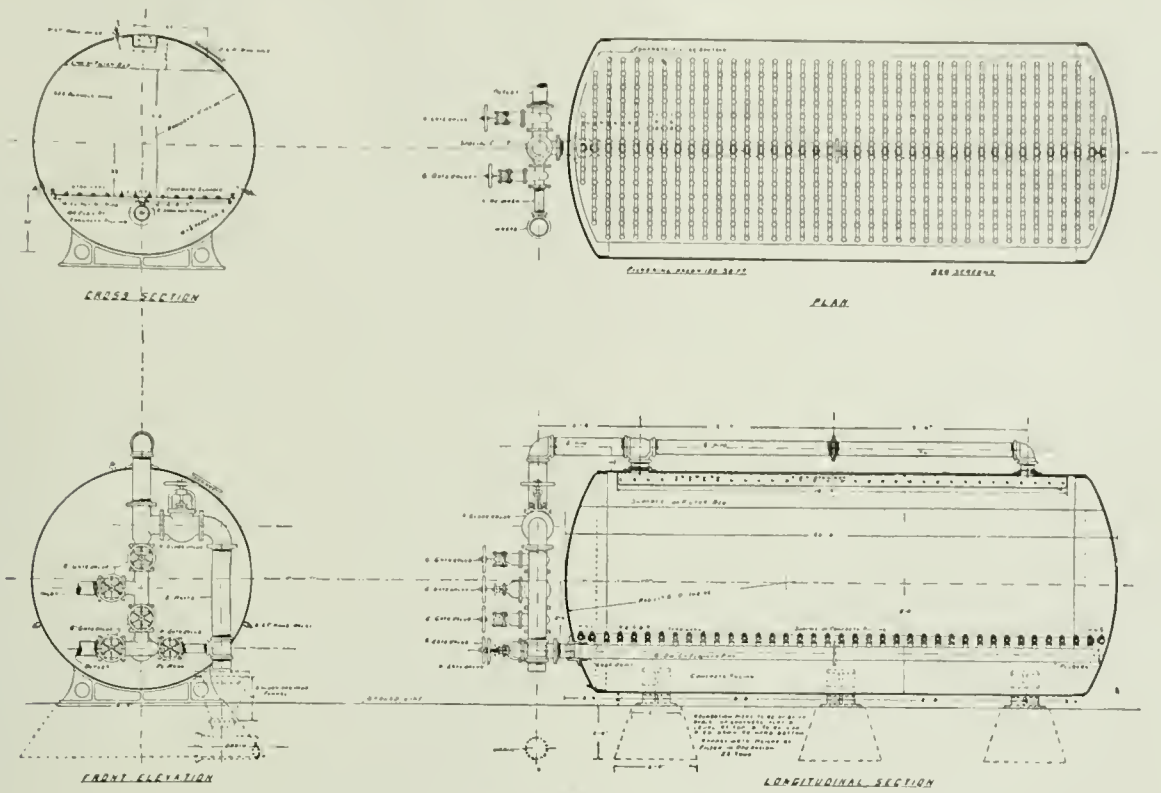
(b) "The filtrate must be clear as possible, and, in regard to color, taste, temperature, and chemical composition, must be no worse than the raw water."

From the above we see that more importance is given to biological purity than to chemical. The German biological standard has been greatly accepted, and makers of mechanical filters undertake to give a guarantee to meet this standard. There is no difficulty whatever, with care and attention in producing an effluent of a higher degree of purity than this standard, as we shall shortly see. It is necessary to reduce bacterial removals to percentage figures in order to compare processes and gage individual efficiencies. It must be noted that percentage removals, no matter how high, are no criterion of the purity of a drinking water, as such percentages may apply to water containing enormous numbers of micro-organisms, and a 99.0 per cent. removal may still leave a number of bacteria far above the standard limit for drinking waters. The percentage removal is an absolute test of the work done by the

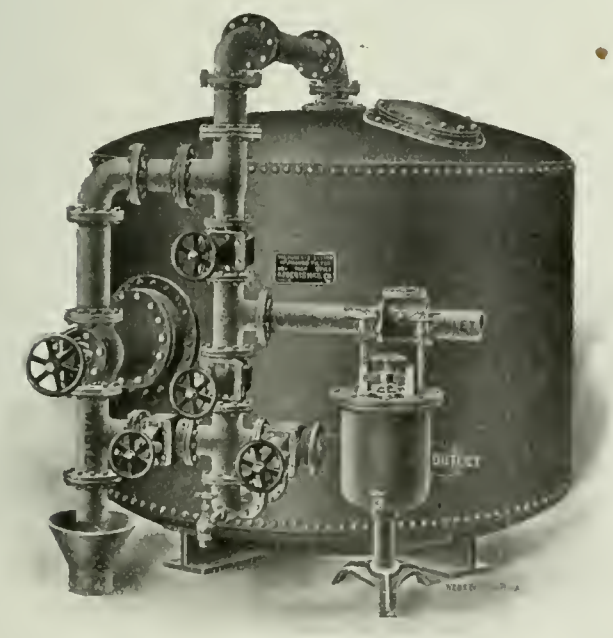
filter; the bacteria remaining is a test of whether the water can possibly be made into a drinking water by the process.

We have said that the addition of a coagulant greatly improves the quality of a filtrate. In this connection we would quote from a Report of the "Joint Special Committee to Examine and Report Relative to the Pollution of the Water Supply and the Best Method of Filtration."—City Document No. 15 of the city of Providence, R.I.:—

"If the diameter of matter floating about in water is much less than that of the interstices between the grains of sand composing the filter-bed, such matter, except as much as is caught upon the sharp edges of the quartz, will go right through the filter with the water.




**Sectional Views of Roberts' Standard Horizontal Pressure Filter.**



**Roberts' Steel Tank "L" Filter.**

"Now, if a substance could be introduced, drop by drop, into the water before it comes to the filter-bed, which would have the effect of curdling the matter together, so that every one hundred or so of the smaller particles were made to join together and become one large particle, much as vapour or steam is condensed into drops, it would follow that they would be caught and held from going through the filter. This is accomplished by adding dissolved sulphate of alumina (alum) to the water as it flows to the filter.

"The amount required is from almost none at all to about three-quarters of a grain, according to the state of the water, say, an average of from one-quarter to one-half grain per gallon in the ordinary condition of the Pawtucket River water.

"The action is the same as when coffee is cleared by means of the white of egg. No white of the egg goes to the drinker of the coffee—it is all drained out with the grounds; and, as no alum goes to the drinker of the water, it unites with the impurities in the water and settles in feathery flakes of insoluble hydrate on the top of the filter, and is washed out with its accumulation of impurities when the filter is cleaned.

"The analysis of the purified water shows no trace of the alumina used, while the analysis of the wash water shows that the alumina is all washed out with other impurities. This feathery bed of precipitate flakes produced by the alum forms a filtering material of insoluble mineral matter which is well nigh perfect in its character. Bacteria are like the very fine particles of clay of some water, so small as to pass the sand or quartz, but they are caught by the feathery precipitate of alumina hydrate, much as the bacteria contained in the air are prevented from entering a vial closed with sterilized cotton."

The above is a very lucid and exact description of the use of a coagulant, and its importance in connection with a filter will be at once appreciated when understood. With reference to the amount of alum required, we may state that one drop of alum solution in one hundred drops of fresh water is an appreciable proportion, and would probably impart a slight taste; one drop in one thousand is scarcely comprehensible; one drop in ten thousand is inconceivable, and would be difficult to detect by the most delicate chemical tests.

One drop of alum in solution to one hundred thousand drops of water (about six-tenths of a grain to the gallon) is sufficient to render an average turbid water bright.

The operating expenses for the Harrisburg mechanical filtration plant for the year 1908 were as follows: Treating 3,358,029,150 gallons, of which 3,271,782,550 were delivered

to the pumps and 86,246,600 gallons, or 2.6 per cent., of the whole used in washing, as follows:—

| | |
|---|---|
| Coagulant | $ 5,919 27 |
| Coal | 2,043 92 |
| Oil and waste | 297 39 |
| Supplies | 837 95 |
| Repairs | 639 89 |
| Laboratory | 1,395 76 |
| Labor | 8,209 33 |
| Total | $19,343 00 |

The above amounts to a charge of $5.91 per million gallons. Coagulant cost per million gallons, $1.81; coal, 62 cents; oil and waste, 9 cents; supplies, 26 cents; repairs, 20 cents; laboratory, 42 cents, and labor, $2.51.

**Analysis of Raw Water and Filtered Water at Harrisburg for the Year 1908.**

| Daily Average for the Month of | Bacteria. | | | Efficiency. | | Turbidity. | | Color. | | Alkalinity. | | | Grains per Gallon Coagulant. | | | Length of Runs. | | % Used in Washing. | Average Rate per Million Gallons per Acre per Day. | Tap Water | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | River. | Sed Basin. | Filtered. | Sed. Basin. | Plant. | River. | Filtered. | River. | Filtered. | River. | Filtered. | Parts Used. | Sed. Basin. | Coag. Basin. | Total | Hours. | Minutes. | | | Bacteria. | Turbidity. | Color. |
| January | 5,059 | 2,040 | 15 | 59.68 | 99.71 | 33 | 0 | 11 | 0 | 13.2 | 6.7 | 6.5 | .48 | .52 | 1.00 | 13 | 58 | 2.7 | 84,492,000 | 16 | 0 | 0 |
| February | 22,152 | 6,610 | 99 | 70.15 | 99.57 | 93 | 0 | 13 | 0 | 25.8 | 19.0 | 6.8 | .82 | .45 | 1.27 | 16 | 12 | 2.3 | 90,914,400 | 83 | 0 | 0 |
| March | 15,894 | 4,113 | 23 | 74.12 | 99.85 | 162 | 0 | 17 | 0 | 13.3 | 4.3 | 9.0 | .89 | .63 | 1.52 | 15 | 50 | 2.4 | 87,100,000 | 22 | 0 | 0 |
| April | 3,812 | 1,165 | 5 | 69.44 | 99.87 | 36 | 0 | 12 | 0 | 12.2 | 5.1 | 7.1 | .60 | .54 | 1.14 | 16 | 49 | 2.0 | 85,487,040 | 9 | 0 | 0 |
| May | 5,168 | 1,283 | 4 | 75.17 | 99.91 | 96 | 0 | 15 | 0 | 12.6 | 4.7 | 7.9 | .73 | .56 | 1.29 | 16 | 06 | 2.2 | 84,388,000 | 13 | 0 | 0 |
| June | 588 | 299 | 6 | 49.92 | 98.98 | 11 | 0 | 6 | 0 | 34.7 | 29.6 | 5.1 | .11 | .61 | .72 | 12 | 47 | 2.6 | 86,676,480 | 26 | 0 | 0 |
| July | 2,275 | 580 | 8 | 74.50 | 99.65 | 119 | 0 | 10 | 0 | 60.0 | 55.6 | 4.4 | .25 | .71 | .96 | 13 | 21 | 2.6 | 87,824,320 | 36 | 0 | 0 |
| August | 654 | 333 | 9 | 49.08 | 98.66 | 21 | 0 | 6 | 0 | 79.6 | 73.5 | 6.1 | .15 | .68 | .83 | 16 | 06 | 2.3 | 83,147,904 | 78 | 0 | 0 |
| September | 997 | 475 | 11 | 52.36 | 98.99 | 12 | 0 | 4 | 0 | 106.9 | 102.6 | 4.3 | .05 | .70 | .75 | 9 | 52 | 3.3 | 87,723,360 | 60 | 0 | 0 |
| October | 1,099 | 873 | 19 | 20.53 | 98.25 | 16 | 0 | 5 | 0 | 98.1 | 92.9 | 5.2 | .20 | .71 | .91 | 9 | 43 | 3.6 | 91,470,960 | 32 | 0 | 0 |
| November | 306 | 223 | 4 | 27.11 | 98.86 | 5 | 0 | 3 | 0 | 98.3 | 90.6 | 7.7 | .50 | .60 | 1.10 | 14 | 15 | 2.1 | 90,400,320 | 6 | 0 | 0 |
| December | 2,731 | 1,473 | 68 | 46.06 | 97.50 | 17 | 0 | 5 | 0 | 95.3 | 85.7 | 9.6 | .62 | .77 | 1.39 | 12 | 12 | 2.6 | 85,240,000 | 59 | 0 | 0 |
| Daily average for the year | 4,949 | 1,662 | 19 | 66.43 | 99.62 | 52 | 0 | 9 | 0 | 54.6 | 47.6 | 7.0 | .45 | .64 | 1.09 | 13 | 29 | 2.6 | 87,658,704 | 36 | 0 | 0 |

The above analysis of a year's working leave nothing to be desired as far as efficiency is concerned, and the results will compare favorably with the averages from slow sand filtration; they will also compare equally with the best results of slow sand filtration. There is no reason why equally good results may not be obtained by proper attention and care at any mechanical plant installation, granted, of course, a properly designed filter of suitable capacity.

By permission of the Roberts Filter Co., of Philadelphia, U.S.A., we are enabled to produce illustrations showing various types of mechanical filters, with sections showing the working parts. Style "L." for instance, per unit, is capable of treating from 84 to 200 gallons per minute, depending on the diameter of the filter.

Some of the main features in connection with the use of mechanical filters in this country are the ease with which they can be cleaned by reversing the water current, the small space they occupy, allowing them to be easily housed and protected from the influence of frost. There is a distinct tendency being shown to adopt this method of filtration of river or surface water in the Western Provinces, where the question of frost is a great consideration.

## SEWAGE DISPOSAL.

### REMOVAL OF PUTRESCIBILITY.

Chapter III. (Continued).

#### Land Intermittent Filtration.

In our last issue we dealt with the question of the removal of putrescibility by discharging settled sewage on to land divided into plots or portions, so that each plot, or portion, would receive a certain dose of sewage intermittently. Certain towns, where this process has been in operation for a considerable time, were quoted, such as Framingham and Brockton, Mass., such being the direct result of the Lawrence experiments; and also at Berlin, Ontario, being the results of experiments carried out by the Ontario Provincial Board of Health. It has been shown that, given a certain quality and quantity of friable soil, satisfactory results may be obtained, as far as the removal of putrescibility is concerned.

In furnishing our readers with the analysis of the effluents from the Framingham and Brockton plants, no mention has been made with reference to removal of bacteria. Referring to the introduction to these articles, several of the experimental tests at the Lawrence Station were quoted, whereby reductions of bacteria were effected amounting to 97 per cent.

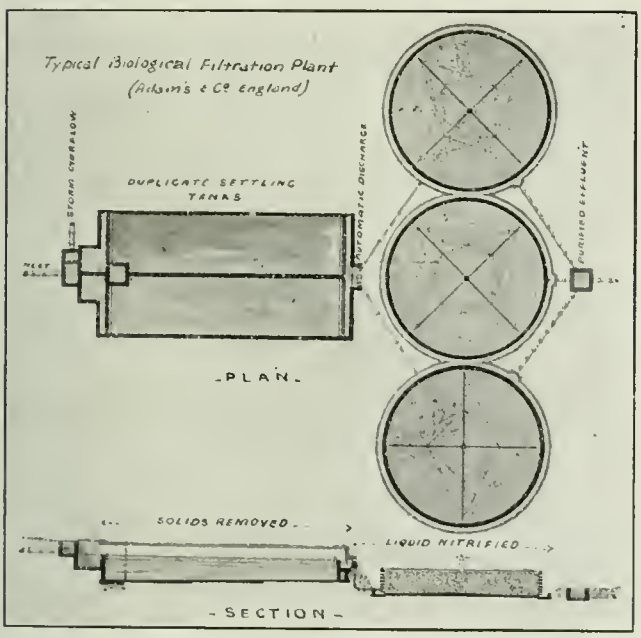
Now it must appear obvious, in order to appreciate exactly a comparison between land intermittent filtration and artificial biological filtration, that more issues must be taken into account than the rendering of a more putrescible effluent. A more putrescible effluent may be obtained by either process. There will always remain, however, many who will incline towards land treatment as biologically efficient and as an economical method of utilizing the manurial properties contained in the sewage as against the apparent wasteful process of artificial biological filtration.

The points now to be dealt with in connection with land intermittent filtration are as follows:

| | ALTRINGHAM | ALDERSHOT CAMP | CROYDON | CAMBRIDGE | LEICESTER | NOTTINGHAM | RUGBY | SOUTH NORWOOD |
|---|---|---|---|---|---|---|---|---|
| Total number of Bacteria (Gelatine at 20 C.) | 263,400 (99%) | 183,266 (99%) | 1,413,200 (95%) | 711,476 (94%) | 532,777 (95%) | Frequently less than 1,000 | 637,133 (97%) | 778,322 (98%) |
| Total number of Bacteria (Agar at 37 C.) | 7,275 (99%) | 37,308 (99%) | 112,000 (97%) | 78,327 (94%) | 70,500 (95%) | Ditto | 81,526 (97%) | 35,157 (99%) |
| B. Coli (Approximate averages) | At least 100, but less than 1,000 per c.c. | At least 1,000, but less than 10,000 per c.c. | At least 1,000, but less than 10,000 per c.c. | At least 1,000, but less than 10,000 per c.c. | At least 1,000, but less than 10,000 per c.c. | Variable, but relatively satisfactory | At least 1,000, but less than 10,000 per c.c. | At least 100, but less than 1,000 per c.c. |

(a) Efficiency with regard to bacterial removal; (b) Utilization of the manurial properties of the sewage on land; (c) Cost of treatment.

There is no doubt but that suitable land is much more efficient as a means of removing bacteria from sewage than the usual methods of sewage biological filtration. With land the particles of filtering material are necessarily much finer and therefore more efficient as a strainer, a very much greater area of filtering area is consequently required per given volume of sewage. The sewage has not only to encounter the perpendicular height of percolation but has also to pass through the lateral extent of area before it reaches the main effluent discharge. The question of bacteria removal, however, is not so much one of comparative degree, so much as whether land treatment is capable of removal to the extent of rendering a water practically more infectious. The percentage removal of bacteria may in the case of both land intermittent and artificial biological filtration be as high as can be produced by even slow sand filtration for drinking waters. The bacteria remaining in the effluents, however, may be far and away above the standard count allowed for drinking water. Referring again to the Lawrence Filter No. 1 where a bacterial efficiency removal of 97.3 per cent. was obtained, we find that the number of bacteria was reduced from about 1½ millions to 40,000 per c.c. The percentage removal is higher than that required in the case of mechanical filter plants by the United




States State Board of Health. The bacteria remaining to the number of 40,000 would require a further percentage removal of 99.6 per cent. to bring the bacterial count within the German standard for drinking waters by not more than 100 bacterial per c.c.

The fifth Report of the Royal Commission on Sewage Disposal states, par 194, page 142: "Our investigations have not shown that there is any essential bacteriological distinction between effluents from land and effluents from artificial filters, though effluents from land usually contain fewer micro-organisms than effluents from the artificial filters which are at present in use. The bacteria in the filter effluents can, however, be largely reduced, if this is necessary, by some additional process, such as sand filtration or sterilization, but for the reasons which are given under the section of this Report dealing with standards, we do not consider that the further process would usually be required."

From the above statement it will be noted that the Commissioners do not consider that there is any essential difference as far as bacterial removal is concerned between land and artificial biological filtration. The term essential must be taken as applying to drinking water standards.

The previous table gives the average figures for the bacteriological analysis of the final effluents from eight land intermittent plants in Great Britain.

A glance at the above biological analysis will convince anyone that in no case can the effluents be termed fit for drinking purposes. The chief advantage of land treatment as compared with other processes is often ascribed to the fact that land is more capable of removing pathogenic germs. This advantage, however, loses a great deal of its importance when we find that the effluents are so far removed from drinking water standards. In Europe the conclusions arrived at are similar to those of the Royal Commission. Schottelius, in connection with the Freiburg sewage and land treatment reduced the number of bacteria in the sewage from 790,600 to 6,700 per c.c. or a reduction of 99.2 per cent. Beckurts and Blaseirs at Brunswick were successful in ob-

(Continued on page 248.)

## SOME FEATURES OF PAVING MATERIALS.

By W. M. Brown, C.E., Collingwood, Ont.

In the consideration of the laying of a good roadway there are primarily the adaptability of the material, also its durability, and cost of execution and maintenance. Where the traffic of vehicles may be conducted with facility, and the surface material offers the least resistance, while there is no protuberance formed or hollow made by the heavy weight of passing wagons, then such a roadway may be considered as well adapted for the purpose intended. The cost of the material and the labor entailed in laying, and the necessary grade in the construction of the roadway, enter largely into the calculations. The engineer's ingenuity is also brought into requisition in the consideration of the subsoil upon which the roadway is to be constructed, as much depends upon its character for the material and manner of manipulation to be adopted. To a community that has to be taxed for the construction, maintenance and repairs of a public roadway, the cost is a very important question. Yet, the kind and quality of the material, as well as the method of construction, should have the greatest consideration, as it is upon this basis that a proper estimate can be obtained which will be productive of the best results. Of course, much will depend also upon the locality where the roadway is to be constructed and the general traffic which it is likely to receive. There are several classes of roadways, viz., those in streets of cities and towns, suburban villages, private drives or country roads. For the paving of streets in cities or towns frequently vitrified brick, sheet asphalt, creosoted wood blocks, stone blocks, or asphalt blocks are adopted. Again, for suburban roadways sometimes macadam, tar macadam, vitrified brick or petrolithic may be utilized, while for ordinary country roads gravel or earth may be adopted.

In the formation and construction of streets in cities and towns, where considerable heavy traffic may be required, or where sewerage or drainage operations are to be taken into account, the kind of material that shall meet these requirements at the least possible cost and give the greatest satisfaction, is the one which shall meet with approval and be adopted. In the forming of public streets, smoothness of vehicular traffic, the minimizing of noise, the facility with which it may be swept and kept clean in a thorough, sanitary condition, and the means of access to sewerage or drainage operations without affecting the materials, and having them replaced satisfactorily in position—these are elements that are worthy of the greatest consideration. Of course, smoothness is a very important factor, but frequently the horses are apt to slip while running at too great a speed, but this may be obviated by reducing the pace and having the horses properly shod. There are some streets in cities where heavy-loaded wagons are prohibited from travelling, and which are strictly reserved for carriage or light vehicular traffic. In such cases materials may be adopted for the highest class of construction that shall have the

greatest durability and permanence, as the traffic is prohibited that would damage or wear the surface by the frequent and heavy weight of loaded wagons. As the pavements of streets in cities or towns are to be so constructed as to meet the valuation of the assessment for such purposes, there are several important features to be considered. Thus, the class of construction that shall be suitable for the parties to be assessed, its cost at first, then the cost of maintenance and repairs, the value of conducting the usual traffic and the effect which may be produced upon the values of adjoining properties, and the general business interests. A residential locality, where the streets are wide and the dwellings of the wealthy are situated, should have the best class of pavement for light vehicular traffic. The greatest smoothness of surface and the minimizing of noise, as well as permanence of construction, should be the essential features, as the rate at which the residents will be assessed should cover all the expense incurred in attaining this high standard of excellence. In the streets where warehouses or manufactories are situated, the class of construction should have the elements which shall meet the requirements of heavy-loaded traffic. The class of traffic has undoubtedly a very detrimental effect, more or less, upon the roadway, according to the construction of the latter. Yet a roadway, according to the roughness of its surface and the difficulty which is experienced in transportation, causes a wear and tear of the vehicles and an over-exertion in the horses employed, that in both cases result in an ultimate loss, which has to be reckoned upon in estimating its cost. It is, therefore, essential to consider the necessary requirements of a street before deciding upon the class of construction which in every respect would be the most suitable. The expenditure to be incurred is usually the basis that regulates the class of material to be adopted and the general method of construction. But we would here indicate some of the kinds of material and the elements in their composition which meet certain requirements in the construction of street paving. For horses the ordinary earth roads, when in proper condition, and creosoted wood blocks when dry, are considered the best. For general wear and tear, the asphalt and brick pavements have proved to be most advantageous. Where the earth roads are in an unsatisfactory condition the wear is considerable, and in the stone block pavements it has been calculated that it is three or four times as great as on asphalt or brick.

In considering the sanitary condition of a street pavement, the permeability of the material is an important factor. For where the surface water and the refuse matter penetrate the material, then a condition may be engendered which will produce detrimental effects upon the health of the community. The objection which is made to stone block pavement is that the joints when not made sufficiently close to keep out the water and dust, is that there is a difficulty of keeping it clean. It is important that the pavement be kept as clean as possible, in order to maintain a healthy condition of the surroundings. Of course, nearly all pavements produce more or less dust, but it should be reduced to a minimum by careful sweeping and watering. Roads which are constructed of earth and broken stones are more apt to wear rapidly, and so produce dust freely in extremely dry weather, and require frequent sprinkling and sweeping to keep them in good sanitary condition. Those elements which have an influence upon the durability of a pavement may be tabulated as follows. The component qualities of the surface material, which may be hard and tough, and so be the better able to resist the abrasion made by the feet of horses or the passing of vehicles. Again, the resistance which the component parts of the material may have upon the variations of the weather and atmospheric influences. The solidity of the foundation also is of importance, so that the loads may be properly distributed, and thus maintain a uniformity on the surface. It is also essential that the roadbed be properly drained to keep the surface dry and enable the traffic to be conducted with facility. These and several other contingencies are mainly the influences which regulate the durability of the material in pavement construction. Blocks of granite, neatly shaped, closely set, and laid upon a firm, unyielding foundation, are considered to form the hardest and most durable surface of any of those pavements which are in common use. For this reason they are frequently adopted for heavy-loaded traffic. Next to stone may be classed asphalt and brick, which are very satisfactory, except under very heavy traffic. There is no doubt that the relative durability of any material in comparison with any other depends upon the composition of the several parts, and the resistance which it affords to those influences of the weather, or the amount of heavy traffic to which it may be subjected. When we come to the consideration of wood as a paving material, we find that, although less durable than other kinds of pavement, and suitable only for comparatively light traffic, yet, if it has no other advantages commensurate with its high cost of maintenance under heavy traffic, especially in a large city, then it would possibly require to be renewed every five or six years. For country or suburban roads, the use of broken stone macadam may be adopted, although its maintenance is generally high in cost, and it wears rapidly under heavy traffic. In some cases permanent pavements may be made of creosoted wood blocks, asphalt, or vitrified brick. Each of these methods, although possessing favorable features in some respects, yet has disadvantages under certain conditions. There are so many considerations to be taken into account in the construction of permanent roadways that it is no easy matter for the engineer to arrive at a decision that would meet all the requirements in every case. However, where the cost is no obstacle in his calculations, then, if he has a suitable subsoil, a good roadbed, well drained and properly graded, and the best of material in its surface composition, well adapted to the climatic and weather variations, and for the class of traffic which is usually conducted, he should have a pavement that will not only be durable, but have also the characteristic features which will be conducive to the health, comfort and convenience of those living in the community.

## THE USE OF TITANIUM RAIL ON THE BALTIMORE AND OHIO RAILROAD.

**By A. W. Thompson, Chief Engineer Maintenance of Way.**

The attention of metallurgists and engineers and all users of iron and steel is being directed toward the remarkable development of alloy steel, or steel containing a percentage of various materials introduced to give it special mecanical qualities. Some of the so-called alloy steels have been known to a more or less extent for a long time. Chrome steel was introduced and extensively used for ore stamps and other purposes over twenty years ago, and about the same time nickel steel was made use of in the manufacture of armor plate. Steel containing tungsten was manufactured by Mushet, who was Bessemer's rival, and manganese steel is nearly as old as the others above mentioned. In general, however, they were confined to limited fields. More recently the use of alloy steel has been greatly extended, and some of the results from the use of these alloys, either singly or in combination, have been astonishing; that is, more than one alloy combined with the iron.

One important factor in bringing these steels into prominence was the need of a metal having exceptional strength and durability, at the same time possessing light weight and occupying small space. The use of such metals was demanded by automobile service and similar light machines which had to withstand especially severe shocks and strains. This probably led to a better knowledge of these alloys, and it was a case where the higher cost of production was not a prohibitive factor.

The requirements of steel alloy might be summed up as follows:

(1) High resistance to shock.
(2) The highest possible elastic limit.
(3) Resistance to abrasion.

(4) More generally the fulfilment of several of these requirements.

Some of the alloys best known to-day are manganese, nickel and chromium. Those last coming into use, but which are more rare, are tungsten or wolfram, molybdenum, vanadium, uranium and titanium.

The actual effect of these alloys is not well understood even by expert metallurgists, but undoubtedly they all add valuable qualities to the steel. The older alloys, such as in the chrome vanadium, steel containing 1 per cent. to 2 per cent. vanadium, have shown most remarkable properties, one of the highest tests yet obtained, after a special treatment, being a maximum breaking strength of 103 tons per square inch, the steel showing at the same time a great resistance to bending and dynamic tests, a combination of properties not usually found.

Nickel vanadium steel shows great strength, but lower resistance to bending and blows.

Manganese in steel acts as an antidote for sulphur and phosphorus and perhaps other impurities, it prevents red-shortness and tends toward the formation of close and uniform crystallization, but an excess of this alloy makes steel cold-short.

The alloy with which we are more particularly concerned in this instance is Titanium. It is practically a new alloy commercially, and, as claimed by the manufacturers, it has only been on the market since October, 1907. Titanium received its name from fanciful allusion to the Titans; its chemical symbol is Ti; its atomic weigth is 48.17.

This metal is not found native, but as manufactured has a dark gray color, having a decided metallic luster resembling iron. It is found frequently combined with the protoxide iron and mixed more or less with the peroxide of the same metal. It is a widely distributed element in nature, being found in many minerals and rocks as well as in clays and soils, resulting from their decomposition, but it nowhere occurs in large quantities in any one location. It has also been detected in meteorites and the sun. It occurs combined also with oxygen, forming titanic dioxide or titanic acid and also in oxygen combinations with iron and calcium, and in some of the silicon. One of its most remarkable properties is its power of combining with nitrogen at a high temperature. Certain copper-colored cubical crystals, which are not infrequently found in the bear of blast furnaces and which were supposed to be pure titanium, were shown later to really be a combination of that element with other elements.

As titanium enters into the composition of so many iron ores, it is natural that it should have been found in many kinds of pig iron. A considerable number of patents have been taken out covering compositions of iron and steel in which titanium has played an important part. The so-called titanic steel was at one time extensively advertised as being of great excellence, but several chemists of reputation were unable to find any portion of this element after making analysis of the metal put upon the market under that name.

According to tests made by the American Foundrymen's Association and reported at their last convention, titanium strengthens cast iron. Gray cast-iron is strengthened about 50 per cent. and white cast-iron is strengthened about 20 per cent. or less. An addition of titanium alloy giving 0.5 per cent. titanium in the casting is sufficient to accomplish the full effect, although more will not be injurious. It is stated that, for titanium alloy containing as much as 10 per cent. titanium, it is well to have the carbon about 5 per cent. as it melts more easily in the ladle.

Titanium imparts valuable properties to steel, but its production commercially on a large scale is retarded because of the technical difficulties in producing the alloy.

An ore called rutile, with a high percentage of titanium, is found in our Southern States, but it has heretofore been used mostly as a pigment in potteries. The electric furnace has, however, admitted of great progress in the separation of these ores, and it is expected that it will be of great commercial value when the large bodies of ore in the Western and Eastern continents can be utilized.

The effect of titanium on steel as understood to-day is to give the metal greater destiny and strength. It unites with the nitrogen, and so far as is known at present, the greater proportion of the titanium apears in the slag, and very little, if any, of it is ever found in the finished material. This indicates its value to be that of a scavenger. It is applied to the hot metal just before pouring, either into the ladle or converter, and the metal allowed to stand from 3 to 15 minutes. The greatest trouble in this seems to be the haste in pouring the metal before the titanium as fully done its work. This haste in pouring is owing to the fear of the metal cooling too much.

The manufacturers claim one more result in the use of titanium, and that is freedom from blowholes and prevention of segregation.

The actual work which the titanium does is not yet fully understood, but it seems beyond question that a better final product results from its use and that a great field is open to engineers and metallurgists to bring the use of this metal under their control, and to obtain all the benefits that may result from using it in steel manufacture.

The experience of the Baltimore & Ohio Railroad with this particular alloy, used in rail, has been, of course, very limited and entirely experimental. During the month of June, 1908, 19 rails were rolled by the Maryland Steel Company, of the usual composition, to which was added 1.5 per cent. titanium alloy. This alloy was claimed to increase the elastic limit, ultimate strength, and remove a large percentage of the slag; also to make the rail less brittle and avoid extreme segregation and blowholes, leaving the metal homogeneous, tough and fine grained. The use of the alloy resulted in a rail with a composition high in carbon and phosphorus, which even then successfully passed the physical test.

The analysis made by the Maryland Steel Company of this rail shows the following:

| C. | Mn. | P. | S. | Si. | N. | O. |
|---|---|---|---|---|---|---|
| 0.701 | 0.92 | 0.086 | 0.048 | 0.079 | 0.004 | Nil |

An analysis made by our engineer of tests, Mr. J. R. Onderdonk,, shows the following:

| C. | Mn. | P. | S. | Si. |
|---|---|---|---|---|
| 0.57 | 0.86 | 0.074 | 0.039 | 0.045 |

These analyses vary somewhat in the percentage of elements, and, as before remarked, both of them show no trace of the element titanium.

The rails above referred to are laid in the eastbound track on the east end of the Cumberland Division, on what is locally known as Kessler's Curve, between Magnolia and Paw-Paw. This eastbound track carries a heavily loaded movement. The grades are light, not over 0.4 per cent. uncompensated, but the curve is a 9-degree, having an elevation of 6.5 in. and a standard gauge of 4 ft. 8¾ in. This curve has an approximate passenger traffic of 480,000 tons per year and a freight traffic of 28,300,000 tons per year. The roadbed is ballasted with broken limestone.

The analysis of the Maryland Steel Company shows that the titanium alloy has a great avidity for nitrogen, and if this is removed a high per cent. of carbon may be possible, producing a harder and yet elastic rail, giving much greater wear.

Through the kindness of Mr. Wm. F. Meredith, president of the Titanium Alloy Manufacturing Company, who controls the present process of manufacture of this alloy, there follows a reproduction of a blueprint showing a combination of tests, indicating the lack of segregation in the Bessemer ingot after treatment with ferro-titanium; also photos of treated and untreated rails, together with a set of micro-photographs of the steel.

It is somewhat unfortunate that the titanium rail was laid partly on the runoff of Kessler's Curve, but any allowance can be made for whatever effect this might have when considering the following tables showing the wear.

Previous to the laying of this titanium rail on Kessler's Curve a test had been made of high carbon open-hearth rail.

(Continued on page 241.)

# LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

**[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]**

## CONSTRUCTON OF CONTRACT.

**Wilson et al vs. Clark et al.**—Messrs. Clark & Adams were contractors for the erection of an extension to the Intercolonial Railway Station at St. John, New Brunswick, and in September 1905 they sublet part of the work to Messrs. Wilson and O'Donnell, under a contract by the latter to drill or punch all holes required in the iron-work on the extension of the station, according to plans and specifications, at the rate of five cents per hole, which will include bolting and rivetting up.

The plaintiffs proceeded with the work and presented their bill charging five cents for the hole in each separate plate to which the defendants objected, claiming the plaintiffs were entitled to be paid only for one hole, though it might pass through a number of plates welded or bolted together; in other words that they could collect 5c. for every hole shown upon the plans but nothing more, regardless as to whether that hole passed through one plate or a number of assembled plates.

The dispute is purely as to the construction and proper meaning of the contract and the Court held the plaintiffs were entitled to payment for every hole in every separate plate.—38 N.B.R. 69.

## FIRE INSURANCE—CASOLINE KEPT ON PREMISES.

**Thompson Against Equity Fire Insurance Company.**—The plaintiff was owner of a drug store in the town of New Liskeard, Ont., and he took out a policy of insurance for $2,000 in the defendant company, to run for one year from 25th May, 1906, and containing the following clause: "The company is not liable for loss or damage occurring while . . . gasoline is . . . kept or stored in the building . . . unless permission is given by the company." The plaintiff had a druggist in his store who occupied the rooms above the store. This man had a gasoline stove and, although no permission had been given by the company, he had used the stove several times and then discarded the same, leaving in it a small quantity of gasoline.

On the 4th of September, 1906, the druggist wanted to make some fruit essences and bethought himself of the stove as a means of heating. He brought it down, left it in a back room and also lighted it. Fire ensued and there was every reason to suppose that it originated from the stove. It appeared at the trial that the greatest quantity of gasoline ever obtained was one-half gallon, and that this was kept by the druggist tenant, without the owner's knowledge and it would seem even against the owner's directions.

Judge Riddell, before whom the case was tried, upheld the plaintiff's claim, reasoning that the words "kept or stored" were no wider than the word "stored" alone, and that the plaintiff did not, nor did his tenant, store gasoline upon the premises. And even said that, to lay aside current euphemisms, the case was an attempt on the part of the fire insurance company to defraud the plaintiff by refusing to pay the loss.

The Ontario Court of Appeal was of much the same opinion but when the case reached the Supreme Court a different construction was put upon the words. The Supreme Court held that "stored or kept" was much wider in meaning than "stored" alone, and meant in case gasoline in any way was kept upon the premises, whether habitually or otherwise, and they dismissed the plaintiff's action.

The plaintiff has now asked for and obtained leave to carry his case to the Privy Council.

## RECKLESS RUNNING OF CAR—INJURY TO INFANT.

**Lott v. Glace Bay Railway Company.**—A motorman in charge seeing a child (two years of age) approaching the tracks sounded the whistle of the car he was driving. The child's attention was attracted and it stopped for a moment and looked at the car, whereupon the motorman applied full speed without waiting to see whether the child retreated or not and without making any further effort to get the child out of its dangerous position. The child resumed its course towards the track and was struck and injured. It was held that the conduct of the motorman was recklessness for which the company was liable. It was no excuse that he was endeavouring to comply with the time-table and prevent delay to passengers, he should have taken proper precautions to avert injury to the child which was too young to exercise discretion.—42 S.C.R. 220.

## SEIZURE BY RAILWAY FOR UNPAID TOLLS.

**Clisdell vs. Kingston & Pembroke Railway Company.**—A company may, like an individual, institute an action for the amount due by way of tolls on goods carried, but by section 345 of the Dominion Railway Act the company may instead "seize the goods in respect whereof such tolls are payable and may detain the same until payment thereof, etc."

The defendant railway company upon several days, the last of which was 15th of August, 1908, carried coal and delivered same to the Wilbur Iron Ore Company upon the latter's own property. The coal thus delivered was stacked in the stock pile upon the Ore Company's property, and the freight charges were not paid.

On the 31st August, the Railway Company, intending to retake, so far as it could be identified, the coal carried and delivered by themselves, took possession of coal from this pile. It transpired that the Wilbur Iron Ore Company was in difficulties and that a winding-up order had been made against it on August 26, and the plaintiff, who had been appointed as liquidator under the order, brought action for the value of the coal the railway had taken and claimed that the latter had no right to the coal but should rank only as an ordinary creditor.

The Court has held that the Railway Company had not by virtue of its Act a lien upon the coal carried to such an extent and of so wide an application as to allow it to retake the goods which had been delivered. The Act does nothing more than confirm and establish the ordinary carrier's lien, which would terminate with the delivery of the goods, and the right of the company to seize and detain should have been exercised and enforced before there was an absolute and unconditional delivery of the goods to the Ore Company, and the plaintiff, the liquidator for the Ore Company, was, therefore, entitled to have the coal returned to his custody.

In the meantime the Railway Company had endeavored to sell the coal but were unable to do so. Upon failure to sell after reasonable efforts, and as the cars on which the coal was placed were required, the coal was mixed with the defendant's own coal and used by the Railway Company for

their own purposes. It was held, therefore, that as the particular coal in question could no longer be followed, the Railway Company were responsible for the fair cash value of same.—18 O.L.R. 169.

### NEGLIGENCE, DANGEROUS OPENING.

**Collins vs. City of St. John.**—In January 1906, one Jane Collins, who was living with her husband at Lepreaux, N.B., crossed by the city's ferry boat to do some shopping in St. John. The boat reached the city side about 8 o'clock in the evening and the usual warning being given that passengers might land, this woman together with others made for the landing but while getting off she fell between the boat and the wharf.

Evidence showed that the particular ferry upon which she crossed did not exactly fit the slip and that when the down tide struck her stern as in this case, the starboard bow was withdrawn from the east side of the wharf and vice versa, leaving an unprotected gap, possibly twenty inches in width. Into this aperture, Mrs. Collins fell and, though she escaped drowning, sustained injuries which resulted in her death two weeks later, and her husband brought this action for damages against the city.

It was held that it was negligence on the part of the city to leave such an opening unguarded, and that if passengers were allowed to disembark at the side, they should have been directed to the gang plank, and there should have been some sort of guarding rail to protect passengers when crossing.—38 N.B.R. 36.

### SHIPS AND SHIPPING—NEGLIGENCE OF MASTER—LIABILITY OF OWNER.

**Grenier et al vs. Connolly.**—In August 1903 the tug known as "Mersey" and owned by Connolly left Quebec and when near Point Outward, on the Lower St. Lawrence, she was wrecked and two of her crew drowned.

This action was to recover damages in consequence of the drownings. After a formal investigation into the cause of the foundering of the ship, the wreck commissioner reported that the ship was seaworthy when she left Quebec on her last voyage, also that her lifeboat and appliances were sufficient to have saved the lives on board had the master made proper use of them, and that the evidence did not explain the cause of the casualty in which these sailors lives were lost. It was also found, however, that the master and mate had been guilty of cowardice and desertion of the ship and their certificates were cancelled. The defendant pled that his ship was seaworthy and that the disaster was due entirely to the perils of the sea and he was not answerable, but the Court has given judgment holding the owner liable. —42 S.C.R. 242.

### THE USE OF TITANIUM RAIL ON THE BALTIMORE AND OHIO RAILWAY.

(Continued from page 239.)

rolled by the Maryland Steel Company, versus Bessemer steel rail, rolled by the Cambria Steel Company; and also a test of high carbon open-hearth steel rail, rolled by the Pennsylvania Steel Company, versus Bessemer rail, rolled by the Cambria Steel Company. The first-mentioned test was started on April 5, 1906, the rail being finally removed in August, 1907, after a life of 15½ months. The section of all these rails was 100-lb. A. S. C. E.

Rail No. 18 of the first test showed the following analysis:

High Carbon Open-Hearth.

| | | | |
|---|---|---|---|
| Carbon | 0.60 | Phosphorus | 0.018 |
| Sulphur | 0.21 | Manganese | 0.500 |

No analysis is on record of the rails of the second test.

The results of the first test are as follows:

| | Wear. | Flow. |
|---|---|---|
| High Rail—Bessemer | 0.54 sq. in. | 0.051 sq. in. |
| High Rail—High C., open-hearth, | 0.48 " | 0.028 " |
| Low Rail—Bessemer | 0.47 " | 0.075 " |
| Low Rail—High C., open-hearth | 0.46 " | 0.048 " |
| Average—Bessemer | 0.505 " | 0.063 " |
| Average—High C., open-hearth | 0.47 " | 0.038 " |

A table showing the wear in square inches of the second test, that is, the Pennsylvania Steel Company's open-hearth rail versus the Bessemer rail rolled by the Cambria Steel Company was as follows:

Pennsylvania Steel Company.

| Time. | —High Rail— Wear. | Flow. | —Low Rail— Wear. | Flow. |
|---|---|---|---|---|
| 5 months | 0.13 | 0.00 | 0.15 | 0.04 |
| 14.5 months | 0.39 | 0.02 | 0.38 | 0.07 |

Bessemer.

| Time. | —High Rail— Wear. | Flow. | —Low Rail— Wear. | Flow. |
|---|---|---|---|---|
| 5 months | 0.15 | 0.00 | 0.15 | 0.04 |
| 14.5 months | 0.42 | 0.01 | 0.40 | 0.10 |

Average Wear.

| | | | |
|---|---|---|---|
| 5 months—Pennsylvania Steel Co. | 0.135 | Bessemer. | 0.15 |
| 14.5 months—Pennsylvania Steel Co. | 0.395 | Bessemer. | 0.41 |

The two previous tests have shown no decided advantage of the open-hearth rail over the Bessemer rail under such heavy traffic and such heavy curvature.

From the observation of the Titanium rail, which has been in track, the following average square inches of wear was indicated:

| | |
|---|---|
| In 2 weeks | 0.027 |
| In 7 weeks | 0.133 |
| In 17 weeks | 0.180 |

An examination of these figures shows that in seven weeks the Titanium rail has worn as much as the other rails in approximately five months. There is something misleading in these figures, as observation on the ground seems to show that the Titanium rail is holding up considerably better than Bessemer rail. These amounts of wear were obtained from the rail section machine, and an examination of the section shows that the Bessemer rail the greater proportion of the wear was on the inside of the head on the high rail and on top of the low rail, while the sections of Titanium rail show the wear to be evenly distributed across the top. This would undoubtedly be due to track conditions; that is, from the effect of the elevation of the curve, and possibly the canting of the rail, but so far these figures show that in one place or another this number of square inches has been abraded from the rail.

Some explanation of this difference of wear may be had from tests which were made with the Scleroscope, the results of which are indicated on sections contained in the report on the Scleroscope. These tests showed most clearly that the surface of the Titanium rail was much softer than the interior, and that only the "skin" of the head was of such soft material. After wearing not more than is shown by the sections taken at the end of seven weeks, the harder material would be reached, and this metal showed about six points harder than an open-hearth rail which was tested. Thus it may be found that the increased life of Titanium rail will begin to show itself after a short period within which the soft "skin" will have been worn away.

All of these tests are in their infancy as to length of time, methods and actual knowledge of the subject being investigated, and only careful records and study will result in trustworthy conclusions.

The above notes are general and are given for what they are worth, as a step toward a better understanding of the whole matter.

The test now in progress on Kessler's Curve is to be carefully followed up, and all discrepancies will be fully investigated and an explanation given as the test progresses, but up to the present time nothing absolutely definite can be stated, as the Titanium rails have been in track only about five months, or rather less than one-half the usual period of service of the ordinary Bessemer rail.

## REINFORCED CONCRETE.

By Arthur C. Auden.

### MATERIALS.

An important point in connection with reinforced concrete frequently presents itself, namely, as to the nearest place where the materials, such as sand and gravel or chippings, can be obtained, and it is a question well worth close consideration because in nearly all instances the cost of the proposed structure will be of course affected by the cost of its constituents, and these are in turn much influenced by the cost of freight and carriage.

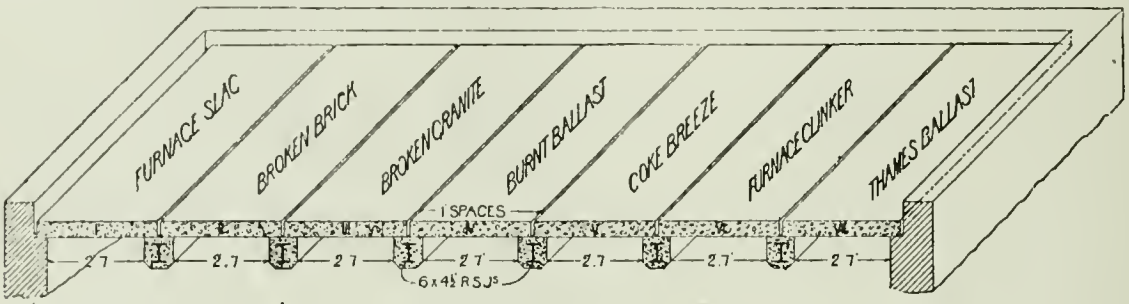
In many places the Eastern Counties flint is practically the only stone locally obtainable, but though this makes good, tough concrete, it is unreliable for fire-resisting purposes owing to its tendency to crack and "fly" under heat.

It is well known that coke breeze makes an excellent class of concrete, but it must be remembered that such cannot be regarded as being really fireproof.

In the case of ashes, only those that will float in water and which are of a uniform color and texture, and quite free from adhering pieces of coal and dirt, should be used, while with clinker only that which is really hard and clean is serviceable. In both cases if the washing and riddling or screening are carried out as one process, a more reliable result will be obtained. The question of sulphur must, however, be carefully watched.

Slag from furnaces, whether blast or cupola, makes also quite a good aggregate, provided it is hard and tough and free from dust, and its sulphur contents carefully noted.

As is well known, all clinkers, breeze, slags, etc., contain a certain amount of sulphur which is apt to attack the reinforcing steel with disastrous results. The maximum




| No. I. | No. II. | No III | No. IV | No V | No VI | No VII |
|---|---|---|---|---|---|---|
| Top: Slab cracked across in two places | Top: Slab cracked across in three places; slight curve downwards | Top. Slab cracked across in three places, curved downward about ¼ in | Top No cracks, not curved downwards | Top No cracks; not curved downwards | Top Slab cracked across in two places, curved downwards about ⅜ in | Top Slab cracked across in very many places, curved downward about 2 in |
| Underside: Curved downwards ¼ in.; slight cracks visible. | Underside Curved downwards ¼ in.; slight cracks visible | Underside. Curved downwards ¼ in. no cracks visible; about 1 in. washed off by water | Underside: Not curved downwards; no cracks visible; about 3 in. washed off underside (in parts) by water | Underside: Not curved; no cracks visible; about 1 in. washed off underside (in parts) by water. | Underside Not curved, one slight crack visible, pitted in places about 1 in deep by water | Underside Curved downward ½ in and bad cracks all over in all directions, mainly longitudinally; much washed off by water |

**Fig 1.—Arrangement and results of Experiments by the British Fire Protection Committee with Concretes, composed of various aggregates.**

The same remarks apply to limestone, but it has not the redeeming feature of being more fire-resisting after being broken; in fact, it is not advisable to be used at all where fire-resistance is an important consideration, as it is very apt to disintegrate to powder under the action of heat, but it is not to be condemned entirely as it is quite a serviceable material apart from increased fire risk.

Sandstone can be obtained in many parts of the country in almost unlimited quantities, but, as a rule, it is too soft, too porous and too absorbent for use in reinforced concrete work. Samples should always be taken and tested by crushing, and if it is found that it will stand about 1½ tons per square inch, and that the difference in weight, when clean and dry and after being two days under water, does not exceed 8 per cent., it may be safely used.

Quartzite stone is fairly good if not too soft and open in texture, in which case the same precautions apply as for sandstone.

With reference to what may be called artificially-produced aggregates, broken earthenware and stoneware from the potteries district make quite a good aggregate, but those who have not had experience with this material for reinforced concrete will be disappointed to learn that the same must be unglazed, thus preventing the use of the many hundreds of tons of broken crockery now existing in some of the older Pottery towns, as the glaze prevents the proper adhesion of the cement; but doubtless this difficulty will be surmounted in time.

Burnt clay and gault are quite permissable materials, provided that they are tough and hard and do not soften or "crumble" after being left in water for two or three days.

Speaking generally, broken bricks are not a good aggregate for reinforced concrete, although they have given excellent results in mass concrete. They are usually too soft and yield too much blunt dust, and have frequently old mortar adhering to them; if, however, they are hard and close in texture and free from mortar they may be safely used

allowable percentage of sulphur in reinforced concrete aggregates is now being made the subject of tests and experiments. There is an important point in connection with the presence of sulphur, namely, that if it is in the form of "sulphate" it is practically harmless, but if in the form of "sulphide" it is very deleterious, and anything more than a very small amount indeed should not be allowed.

Care should also be taken with all artificial aggregates that no free lime is present; but, as in the case of sulphur, there are two forms of this material present, one the free lime referred to, which is dangerous and the other carbonate of lime which is practically harmless.

Before leaving the subject of aggregates, the author would draw attention to the recent important fire tests,

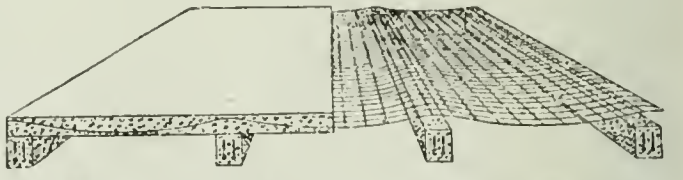


**Fig. 2.—Reinforcement of Flat Surfaces; Wires or Rods held in place by Weaving.**

made by the British Fire Prevention Committee, of concrete composed of various descriptions of material, the proportion of cement, sand and aggregate being identical in each case, i. e., 1-2-3, except with the burnt clay and coke breeze where there was no sand, the proportion being 1-0-5. The illustration, Fig. 1, kindly supplied by the British Fire Prevention Committee, shows diagrammatically the arrangement of the test, which was simultaneous, and exactly the same for all the slabs, which were all uniformly loaded to 224 lbs. per foot super. The remarks printed beneath each slab are of much interest as showing the behaviour of each

material after being quenched with water when practically red-hot. The slabs were all 10 ft. by 2 ft. 7 in. clear span. Engineers will be interested to know that the furnace clinker mentioned was obtained from off the bars of an ordinary steam boiler, not from destructors.

### Sand.

Sand is, in some parts of the country, more difficult to obtain than any other constituent of reinforced concrete. A certain amount is absolutely necessary, and nothing up to the present is known which really and entirely supplies its place. Engineers having foundries will have a ready means of judging sand for reinforced concrete if they remember that, generally speaking, the better sand is for moulding, the worse it is for reinforced concrete. For instance, it must not "bind," that is, retain any shape when compressed, and it must be incapable of being smoothed with a trowel to a bright surface, or of "standing up" by itself when cut with a shovel; these being "rough-and-ready"

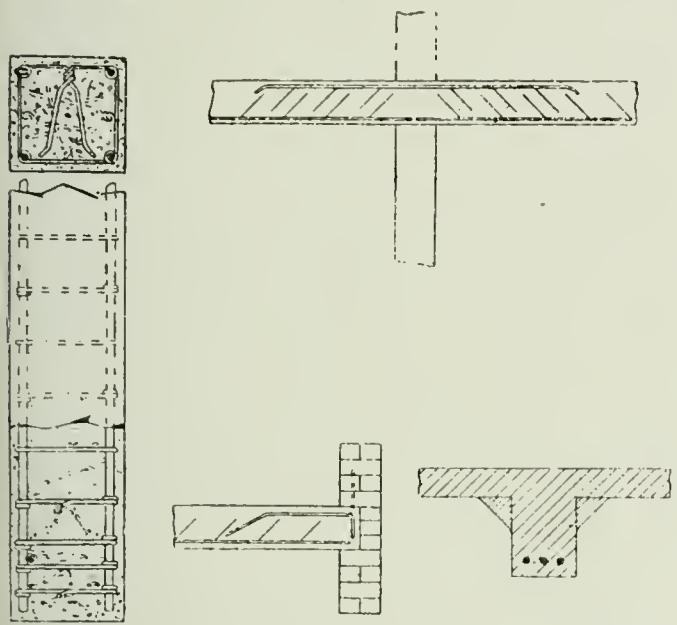


Fig. 3.—Arrangement of Column Reinforcement with vertical Rods and Loop-pieces.

Fig. 4.—Diagram showing Arrangement of Reinforcing bars and Shear Members to resist "Reverse Flexure" in Continuous Beam.

Fig. 5.—Diagram showing arrangement of Reinforcing Rods and Shear Members to resist "Reverse Flexure" in end of beam.

Fig. 6.—Diagram of Section of Beam and Floor showing increased area of Concrete in Compression.

methods of ascertainnig that the sand has what is required, namely, large sharp grains. Dirt in the form of slime, mud, or vegetable refuse is distinctly bad.

If sand is scarce or costly, some economy may be effected by regarding the very small pieces of the stone or other aggregate, below 1/8 in mesh, as sand, and mixing them with some real sand. The economy is not so apparent as appears at first because the small pieces must be screened out from the larger aggregate, and in most instances washed to remove the floury dust before being mixed with the real sand, ready for putting in the gauge boxes.

### Reinforcement.

It is important that all reinforcement should be so designed as to possess a considerable amount of initial rigidity, so that it does not "sag" or "warp" or "twist" when placed in position in the mould boxes. Many illustrations regarding this could be quoted, but that of compression bars intended to be above the neutral axis in a beam, sagging down by their own weight till a portion of their length is below the said axis, where it is worse than useless, is not by any means as rare as it should be. The same remarks apply to lateral misplacement, particularly in the case of columns and struts, as well as to the pitching and spacing of reinforced bars or metal on flat surfaces such as floors, walls, etc. In these last-mentioned it is practically essential to have the bars or metal so designed that they cannot be knocked out of place, as it is almost impossible to keep a number of separate loose bars in proper pitch; it is advisable therefore that all reinforcements for this form of work be woven together, as shown in Fig. 2.

Punching or slitting solid plates into strips or bars is another efficient form of reinforcement for flat surfaces, particularly for those which are approximately square in plan, viz., where the strains are practically equal all over; but for flats where the length is considerably greater than the span, a wire meshing is cheaper as the cross-span wires take the load, the longitudinal ones being only necessary to keep the others in pitch, and it is not advisable to pay for metal and strength in the longitudinal directions where it is not wanted.

### Auxiliary Tension Members in Beams and Slabs.

An examination of all the accepted specifications, for the last ten years, dealing with reinforcements will show that it is almost universally acknowledged that these important accessories must be inclined to the main tension bars and not be at right angles thereto, and also that such bars must be so designated as to retain absolutely their positions where they are connected to the main tension bars and cannot be slipped or moved along the same when ramming the concrete or otherwise.

### Reinforcements of Struts and Columns.

There are two very distinct methods of reinforcement in use for these—one being that in which the vertical bars are prevented from spreading by being spirally wound with rods of wire, and the other where the same end is obtained by means of rings or loops of wire tying the vertical bars together, such loops or rings being arranged at various distances apart to suit the design and strength desired. Both these methods have good and bad points, each one being the best under appropriate conditions.

The spiral winding has given most excellent results, and is considered by many to be the best for columns, etc., as it permits the use of lighter and fewer vertical rods, but it has the disadvantage of being somewhat difficult to make it a "good mechanical job," that is, so that the spirals shall all be the same diameter and parallel in bore, otherwise some will clasp the group of vertical bars too closely and others hardly touch them, which results in unequal stresses.

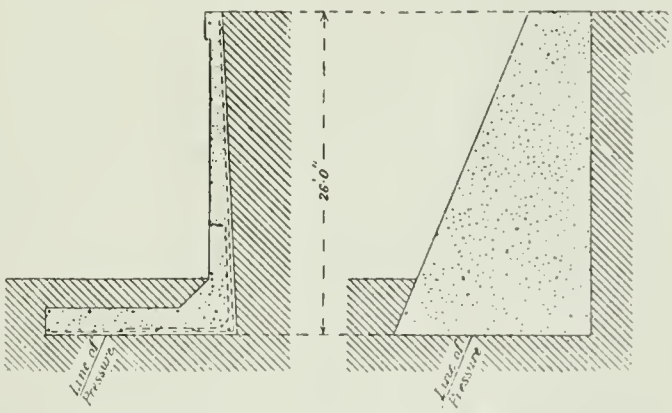



Fig. 7.—Comparison between Amount of Material required and useful space occupied in Mass Concrete and Reinforced Concrete Dock or Retaining Walls.

This is, however, generally made much easier by using bands of flat rectangular section which bend readily, and by first winding the spirals on a cylinder and then slipping them over the vertical bars when made. Great care must be taken when using spiral reinforcement in vertical columns that it is not made in too long lengths, as all the concrete has to be put in from the top of each length, and it is well known that when concrete is dropped from even a small height the mixture of its constituents becomes very uncertain. Care must also be taken that each length of spiral is "corkscrewed" well into the one below it, or otherwise there is a plane of weakness between each length of spiral. This form of reinforcement must be so designed

that the required strength is obtained without the pitch of the spiral being closer together than the size of the largest pieces of aggregate used, as if it is so, the stones become jammed between the coils and a lack of homogeneity is the result.

The second method of column and strut reinforcement above-mentioned, namely, loops or rings slipped over the vertical bars and held at the proper distance apart, as shown in Fig. 3, is also an excellent one, especially when the loops are carefully made mechanically on hard metal formers, so that each one is an exact replica of its neighbour; the result being that each one equally clasps the group of vertical bars, otherwise should one be tight and the other slack the bursting strains will not be taken up by all the loops in equal proportions. As the first desiratum of this design of column and strut reinforcement is the prevention of the vertical rods spreading apart under the load (the loops themselves, being further apart, do not resist the bursting strains on the concrete to the same extent as the spiral windings), it is not good practice to allow the loops to be curved in between the points where they touch the vertical bars. Unless the wire or rodding forming the loop is straight between its resistance points, it does not get a chance to develop its tensional strength, as it must "pull itself straight" first, which it does at a low stress. For this reason the use of comparatively high-carbon steel is often recommended for columns or strut loops, as it is stiffer to resist distortion, and as distortion is one of the main things to avoid, particularly in this phase of reinforcement, the use of harder steel, if the same can be obtained without any marked increase in cost, appears to be certainly indicated; in fact, as the elastic limit of all reinforcement is almost of as great importance as its ultimate strength, the use of bars and rods possessing considerable resistance to stretching is certainly to be recommended, provided that the said ultimate strength is not appreciably decreased. The use of high-carbon steels has been recommended for various other reasons.

It is often said that it is immaterial whether the reinforcing rods are bent or not, as, being bedded in concrete, they are immovable, and doubtless this may be true in a structure where there is no vibration and where the loads are unvarying in amount and disposition; but where it is not so, there is a tendency on the part of the concrete on the concave side of the curved pieces of wire or rodding to become friable, and this tendency should be eliminated in the design by working the reinforcement in straight lines whenever possible. It should also be noted that all the joints of the vertical rods in columns and struts must be in close fitting sleeves—preferably of good quality lap-welded steam barrel.

When designing reinforcement there are, of course, many points for consideration quite irrespective of the particular method of constructing or attaching the various parts or members, one of the principal being that all beams or floors running continuously over the tops of columns or stanchions or walls must be reinforced above their neutral axis where they pass over the said columns, in exactly the same way as they are reinforced below that axis in their clear span, as the parts in tension and compression are reversed in these circumstances. In one well-known system the bars are run along both top and bottom surfaces from end to end, but these rods or bars in the compression area or loops or stirrups in position, not as reinforcement or loops or stirrups in position, not as reinforcement against reverse flexure, nor as such in compression, this last not being needed unless the area above the neutral axis is such that it cannot stand the allowable crushing stress.

The exact position of this neutral transverse—or, more correctly speaking, diagonal—plane of "reverse flexure" has not so far been very exactly located, and it will, of course, vary with every variation in the distribution of the load. The present practice is therefore to design the reinforcement, over the supports, to overlap the ends of that which runs along the "belly" of the beam. The diagonal auxiliary shear-members connected to each of the main tension bars above and below the neutral axis thus become parallel to each other, as shown diagrammatically in Fig. 4, in the same way as the tension members in a lattice girder. The same arrangement must be carried out where the ends of beams rest on and in walls, and the diagram, Fig. 5, shows the reinforcements against tension due to the same reverse flexure above the neutral axis under these conditions. As will be noted, the ends of the bars are bent downwards into the beam itself when only the beam is reinforced concrete, but, should the whole structure be of this material, the beams and walls consequently being all monolithic, it is better practice to bend the bars upwards, as shown in the dotted lines, this being also handier as the men can readily see, and, if necessary, adjust, any bar which may have been displaced by punning or otherwise.

When designing long and deep beams or girders such as for a railway bridge with flat (not arched) spans, it will also, not infrequently, be found that the available area of concrete in compression above the neutral axis is such that the stress per square inch is more than the concrete will safely stand, that is, more than 550 to 750 lbs. per square inch, according to the class of concrete and the nature of the aggregate used; but this is easily overcome by using reinforcement in the compression area, always remembering that the value of steel in compression is 50 per cent. less than that of the same in tension. Here also the question of rigidity to resist deformation under compression is important, exactly as it is in columns and struts, and care must be taken that all the separate members in compression are properly braced together to avoid the tendency to spread in any direction, but particularly sideways and downwards. Even with ordinary beams supporting floors this question of the available area of concrete in compression demands consideration, but, the floor and beam being all in one solid piece, not only does the part of the floor immediately over the beam contribute to the desired area, but portions of the floor on each side of this are available also, thus enabling us to regard the beams as of T section, as shown in Fig. 6, but except under special conditions of loading, the breadth of floor which we can consider for the purpose of this calculation should not exceed four to six times the breadth of the beam itself, according to the class of concrete and the nature of the aggregate used. But even with this reservations this fact of the beams and floors being solid together enables a wonderfully strong and light structure to be obtained. The same diagram also shows in closer section an additional means of obtaining this larger area of concrete in compression, namely, that of making fillets at the junction of the beam with the floor.

Another point to be remembered is that temperature stresses must be carefully guarded against and that extra reinforcement, in fact, increased scantlings over all, must frequently be adopted for this purpose, as the co-efficient of expansion of steel and of concrete is practically the same. In structures such as bridges these variations due to the temperature can be arranged for the ordinary hinges or expansion joints (of which the latter can be very rapidly and effectively made with thick sheet-lead, the area being such that no pressure it will experience will cause it to "squeeze out"), but in the case of structures where such are impossible, as for instance, in an exposed tank or bunker or silo, the only remedy appears to be a general increase in strength, particularly by means of increased reinforcement, and, although perhaps contrary to theory, this method has proved perfectly successful.

### Centring.

With reference to the design and erection of forms or centring for keeping the soft wet concrete in place till it is properly set, there are two main conditions which must always be fulfilled. Firstly, it must be so supported and stayed that neither the weight of the concrete, nor the ramming of it, can make the centring bulge or sag; and secondly, it must be as close-jointed as possible, otherwise the

water will leak out and carry with it an appreciable amount of cement, which will weaken the structure. There are many methods of obtaining a smooth face on the finished concrete, such as painting the boards with oil or whitewash, or any material to prevent the concrete adhering to them, but, given fair flush joints in the woodwork, the passing of a thin piece of sheet steel (an old hand-saw with the teeth ground off is excellent for this purpose), between the concrete and the boards gives perhaps the best result whenever the general arrangement permits of its use. When work is to be floated or rendered, a rough surface is, of course, desirable.

The question of centring leads naturally to that of the length of time it should remain in place. The author is frequently asked to state his opinion on this in general, but no general or hard-and fast rule is possible—on some jobs or portions of them, 24 hours is ample, on others six weeks is too short. Much depends on the weather, particularly on frost, but, most of all and beyond everything, on experience; in fact, there is no material where experience on the part of the constructors is more important than in all matters connected with reinforced concrete or where more disastrous consequences are likely to follow the lack of such experience.

A contractor with considerable resources in the way of plant and materials is also very advisable. It is not long ago since a somewhat serious collapse occurred in a job where the concrete was put in on a Friday and the centring struck on the Monday, as the contractor had not, and could not get, any more timber.

### Methods of Using.

Buildings in General.—All buildings should be of skeleton framework construction. The spaces or panels between the columns and beams can be ½ in., filled in with reinforced concrete or with brickwork, or the whole frame covered with a skin of stone or brick; but as the main strength is in the frame, such panels can be quite thin, in fact, only of such thickness as is needed for dryness, not for strength, which results in a large increase in floor area, particularly in the lower storeys, where, otherwise, the walls would have to be of considerable thickness.

Boats and Barges.—These have been successfully built for several years, and, provided several are ordered of one size, that is, made off the same moulds, they are very much cheaper than steel.

Chimneys.—From current quotations these certainly appear to be cheaper than the same in brickwork, and, of course, do not need pointing; but there may be a difficulty when one needs to be felled, as at present it is not known how to bring one down in a small area. It is, however, a simple matter if there is space available for the chimney to fall in one length.

Drain and Sewer Pipes.—Many miles of these have now been laid and are giving great satisfaction both as regards first cost and upkeep. Great care is, however, necessary in their manufacture to ensure the reinforcement, both longitudinal and circular, being exactly in its correct position, otherwise there is a great risk if the sewage or water reaching some of the metal and the life of the pipes being therefore very short. One of the great advantages of reinforced concrete sewer pipes—particularly in bad ground, for instance, over old mine workings—is that they do not cost any more per yard when made in long lengths, up to, say, 18 ft. if required; thus about 75 per cent. in the number of joints is saved, and they are able to carry the weight of themselves and contents over spans practically equal to their own lengths. The same remarks also apply to water pipes.

Dock, Retaining and Reservoir Walls.—The author has already noted the saving in space in buildings due to the use of reinforced concrete, and the illustrations in Fig. 7 show that such is even more the case with these walls, the one being in reinforced, and the other in mass concrete. Both are drawn to the same scale and calculated for the the same strength with the same factor of safety.

Engine and Dynamo Beds. — Probably many readers will remember the case of a large and important hotel in London having its own electric installation, where the vibration from its large turbo-alternator sets was a cause of serious complaint, notwithstanding the use of many different forms of soft anti-vibration materials beneath the beds. Finally, reinforced concrete bedplates were tried, the same being practically replicas (in plan) of the cast-iron ones, which rested on them, but only about 8 in. thick. These reinforced concrete bedplates are very carefully reinforced, and are only supported at points, that is, they do not rest directly on the old solid stone beds. The result has been very satisfactory, the difficulty of the vibration having been entirely eliminated.

Fence Posts.—The use of these is increasing very rapidly, but up to the present they are rather handicapped by the want of a cheaper method of attaching the wires to them, the ordinary hooks or staples being practically inadmissible, as they get bent and broken when the posts are bundled for carriage, and clips and bands or screw-plates are costly.

Magazines for Explosives, etc.—Owing to its practically absolute fireproofness, reinforced concrete is particularly suitable for these structures, and recent large and costly experiments in Germany have proved that even the explosion of huts containing 1½ to 2 tons of gelatine dynamite did no damage to their surroundings other than from the air blast. It was found that the reinforcement was only rent, but not scattered, and the concrete blown away in the form of coarse dust.

Piles, Piers and Jetties.—One of the principal points to bear in mind when considering the use of reinforced concrete piles is that they will safely carry about three times the load of such in wood of the same cross-sectional area; also, that they are no more difficult to drive; and, with reference to piers and jetties, the use of a material which does not deteriorate "twixt wind and water" is a matter worthy of very careful consideration.

Pithead gears and pit props.—These being fireproof is their strongest recommendation, and the latter, if made hollow, are, strength for strength, but very little heavier than ordinary wooden props.

Railway Sleepers.—As the most important question in relation to these is their life, not their strength, nothing but time will prove whether the use of reinforced concrete at a somewhat higher cost than wood will be the more economical in the end, but about five and a half to six years' experience of sleepers in continuous service under heavy traffic and rolling stock so far show no appreciable difference from the day they were laid down, and a recent order for over 100,000 of such shows that they are being extensively adopted.

### Painting.

The question of painting, although only now referred to, is one of vital importance with all reinforced concrete structures (other than buildings such as houses, offices, etc., which are usually plastered and papered), as it is well known that all naked steel and iron work deteriorates rapidly from rust and corrosion unless it is periodically very carefully scraped and painted. Even when this is done, the amount which is, rightly, deducted for depreciation in the case of a valuation for sale, transfer, mortgage or similar, is very marked, in addition to the actual cost of such scraping and painting. This is particularly the case with bridges, owing to their exposed position, and the expense of painting them is frequently considerably increased by the extra cost of the necessary cradling and scaffolding. All this is eliminated in the case of reinforced concrete, which increases in strength with age, and is not subject to depreciation, nor are painting or scraping or other methods of preservation necessary. In fact, when comparing the cost of a reinforced concrete structure with that of a similar one in other materials, it is quite a good rule to work out the cost of the painting and upkeep, and, having capitalized the same at a rate per annum (say, 1 per cent. over the current bank rate), to deduct this sum from the estimated cost of the reinforced concrete in order to place both propositions on an equal basis for purposes of comparison.

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ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

## COMING MEETINGS.

**Canadian Forestry Association.**—At Regina, Sask., September 3rd and 4th. Special meeting. James Lawlor, 11 Queen's Park, Toronto, Ont.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# ASTRONOMICAL PAGE

Star Map for September 1st, 1909, 10 p.m.

## STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., SEPTEMBER 1st, IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for September 15th at transit across the meridian of 5h W. of Greenwich.

| Star | Mag. | R. A. h. m. s. | Decl. ° ′ ″ |
|---|---|---|---|
| α Andromedæ | 2.1 | 0 03 43.4 | + 28 35 30 |
| β Cassiop. | 2 4 | 0 04 22.2 | + 58 39 02 |
| α Cassiop. | 2.5 | 0 35 23.3 | + 56 02 26 |
| γ Cassiop. | 2 3 | 0 51 15.8 | + 60 13 33 |
| α Ursæ Min. (Polaris) | 2.1 | 1 27 21.3 | + 88 49 14 |
| α Arietis | 2 2 | 2 02 04 7 | + 23 02 08 |
| β Ursæ Maj. | 2.4 | 10 56 21.0 | + 56 52 09 |
| α Ursæ Maj. | 2.0 | 10 58 06.5 | + 62 14 28 |
| γ Ursæ Maj. | 2.5 | 11 49 02 4 | + 54 12 01 |
| δ Ursæ Maj. | 3.4 | 12 10 55.0 | + 57 32 17 |
| ε Ursæ Maj. | 1.8 | 12 50 01.0 | + 56 27 15 |
| ζ Ursæ Maj. | 2.1 | 13 20 15 2 | + 55 24 05 |
| η Ursæ Maj. | 1.9 | 13 43 57.0 | + 49 46 07 |
| α Ophiuchi | 2.1 | 17 30 43.7 | + 12 37 40 |
| α Lyræ (Vega) | 0.1 | 18 33 52.7 | + 38 42 09 |
| α Aquilæ (Altair) | 0 9 | 19 46 22.5 | + 8 37 50 |
| α Cygni | 1.3 | 20 38 21.7 | + 44 57 34 |
| β Pegasi | 2 4 | 22 59 24.1 | + 27 35 35 |
| α Pegasi | 2 6 | 23 00 16 0 | + 14 4311 |

### Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on September 1st, 1909, for places in longitude 5th (= 75°) W., and at certain standard times T:

| T | Sid. Time | Lat. = 44° | | Lat. = 48° | | Lat. = 52° | |
|---|---|---|---|---|---|---|---|
| P.M. h. m. | h. m. s. | ° ′ ″ A | a ″ | ° ′ ″ A | a ″ | ° ′ ″ A | a ″ |
| 8 00 | 18 42 10.0 | 1 36 05 | + 5 | 1 43 13 | + 5 | 1 52 06 | + 6 |
| 8 30 | 19 12 14.9 | 38 01 | + 2 | 45 20 | + 2 | 54 28 | + 2 |
| 9 00 | 19 42 19.8 | 38 16 | — 2 | 45 40 | — 2 | 54 52 | — 2 |
| 9 30 | 20 12 24.8 | 36 50 | — 5 | 44 10 | — 5 | 53 17 | — 6 |
| 10 00 | 20 42 29.7 | 33 43 | — 8 | 40 51 | — 9 | 49 43 | —10 |
| 10 30 | 21 12 34.6 | 28 57 | —11 | 35 45 | —12 | 44 13 | —13 |
| 11 00 | 21 42 39.6 | 22 37 | —14 | 28 58 | —15 | 36 54 | —17 |
| 11 30 | 22 12 44.5 | 14 49 | —17 | 20 35 | —18 | 27 47 | —20 |
| 12 00 | 22 42 49.4 | 05 41 | —19 | 10 46 | —21 | 17 06 | —23 |

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.
T = the time for September 1st.
L = the longitude.
d = number of days elapsed since September 1st.

CUT HERE FOR REFERENCE.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° ( = 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on September 8th.

Here the interpolated value of the azimuth for 8h 30m is 1° 48′ 10″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 ( = 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

**Determination of Time.**

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) — (L — 5h)$.

Where

S = the required sid. time.

S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\alpha — S)\ (1 — 0s.16)$.

Where

T = the required standard time of transit of the star, and

T′ = the tabular time corresponding to S′.

$\alpha$ = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star Altair is observed at the watch time 8h. 56m. 49s. 5 at the same place and date as above; to find its correction on standard time.

| | h. | m. | s. |
|---|---|---|---|
| Sidereal time, 9h. 00m. (table)..... | = 19 | 42 | 19.8 |
| 7 × (3m 56s. 555) ..... | = | 27 | 35.9 |
| | 20 | 09 | 55.7 |
| Difference of longitude ..... | = | 20 | 00 |
| S ..... | = 19 | 49 | 55.7 |
| R.A. of star ..... | = 19 | 46 | 22.5 |
| $\alpha$ — S ..... | = — | 3 | 33.2 |
| 3.6 × 0s.16 ..... | = | | 0.6 |
| Equivalent mean time interval..... | = — | 3 | 32.6 |
| T′ ..... | = 9 | 00 | 00 |
| T ..... | = 8 | 56 | 27.4 |
| Watch ..... | = 8 | 56 | 49.5 |
| Watch fast ..... | = | | 22.1 |

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

## REMOVAL OF PUTRESCIBILITY.

(Continued from page 237.)

taining a 99.7 per cent. reduction, viz., 2,000,000 to 5,500 per c.c. The Berlin sewage showed a count of deplorable bacteria to the amount of 12,750,000 per c.c.; the effluent containing only 3,570 per c.c. or a reduction of 99.9 per cent.

All this points to one definite conclusion, that the effluent from the very best of well managed sewage farms is never suitable for drinking purposes. Such effluents invariably retain the bacteriological characteristics of sewage. The best effluents contain B. coli in considerable numbers, and it must be assumed that even typhoid germs may pass through the soil and reach the streams receiving the effluents. Dr Houston has made this evident in the thorough investigations he has made for the Royal Commission.

It is, however, apparent that land intermittent filtration properly managed may produce a very high efficiency in bacterial removal. Fortunately the pathogenic bacteria of sewage are not found isolated and free to move about in the sewage liquid, they are generally enclosed or in contact with diarrhœa stools or wrapt up in gelatinous masses or generally attached to suspended matter. If the solids in suspension are first allowed to settle in tanks, a percentage of bacteria about equal to the amount of settled solids will be removed by this preliminary treatment, and further methods of straining or filtering will have an effect of still greater reduction. The main point to be kept in mind is that if the water receiving sewage effluents either raw or treated is to be used for drinking purposes such water should be treated by one of the many well known methods for biological purification.

The utilization of the manurial properties contained in sewage is frequently an argument in favour of land treatment. The most important manurial constituent in sewage is the ammonia which is the product of the fermentation of urea of the urine. Sewage also contains organic nitrogen in a smaller quantity as well as potash salts and phosphates. With artificial biological filtration, part of the ammonia and other organic compounds disappear in the form of gases, part is assimilated by the vegetable growths in connection with the bacteria film and the remainder of the nitrogen is oxidized into nitrate. The following table shows the amount of nitrogen which are used up or disappear in land as compared with other methods. (Royal Commission, par 205.):

| | Percentage of the Nitrogen of Sewage or Sewage Liquor which disappears during the process of purification. |
|---|---|
| Land intermittent filtration.... | about 60 per cent. |
| Percolating biological filters... | 40 to 50 per cent. |
| Septic liquor in contact beds... | 40 to 45 per cent. |
| Septic liquor in percolating beds | 30 to 40 % or less. |

From the above it will be seen that there is from 10 to 30 per cent. more nitrogen retained or used up in soil than in artificial methods, the balance has chiefly vanished by being used up by growing crops. Much has been written of the general loss of nitrogen and its non-utilization by the adoption of artificial filtration. It must be remembered, however, that it is only in the form of nitrates that nitrogen can be of any benefit to plant life, and that the production of nitrates in soil in winter time almost ceases. Speaking generally, intermittent land filtration has only proven successful when crop growing has been entirely subservient to purification of the sewage. It is practically necessary to dose land, unless the area is very large, almost continuously. On the other hand there are times, especially in wet weather, when the plant life is destroyed by the excess of sewage liquid. No case is known where a profit is shown by growing crops in sewage dosed land when all the costs of sewage treatment are considered. Theoretically the value of a domestic sewage has been calculated at from $1 to $1.25 per head per annum. No returns in practice have come anywhere near this figure.

Over and over again the system has been tried in Great Britain and in Europe of renting the plots of land used for intermittent filtration to gardeners and others who desired to cultivate the land, the system has invariably proved a failure. All kinds of tricks are resorted to by the tenants of the plots to divert the sewage in wet weather from the land surface, by making holes direct to the underdrains or opening sluices and diverting the sewage direct to the stream. It must be either a question of sewage treatment or cropping, if cropping the purification will suffer. All the wild schemes in the past of utilizing domestic sewage for purposes of profit have proved bubbles, and it is only in exceptional cases of trade effluents and grease recovery that by-products have been made to show any profit.

(To be Continued.)

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received up to noon on Tuesday, 14th September for the enlargement of the city's aqueduct, by widening and deepening the same on a length of about 27,300 feet. The work comprises about 1,176,000 cubic yards of earth excavation and about 400,000 cubic yards of rock excavation, also the formation of the slopes and banks of the widened aqueduct, the transporting to a distance of excess of excavated material, the construction of syphon culverts, the construction of dry stone wall lining in the slopes, etc., etc., the whole according to plans, cross-sections and specifications, to be obtained from George Janin, superintendent and chief engineer of the Montreal Waterworks, City Hall. (Advertised in Canadian Engineer.)

MONTREAL.—Tenders for electric light wiring and fittings for the addition to Montreal Post Office will be received until 5 p.m., Wednesday, August 25. Plans and specifications to be seen on application to A. Venne, architect, Montreal, and Napoleon Tessier, secretary, Department of Public Works, Ottawa.

MARIEVILLE.—Tenders will be received till September 6th next for the improvements of the waterworks. M. J. Meunier, civil engineer, 15 St. Lawrence Boulevard, Montreal. H. St. Marie, secretary-treas.

SHERBROOKE.—Tenders for customs fittings, etc., will be received until Wednesday, September 1. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**Ontario.**

PETERBOROUGH.—Tenders received up to 4 o'clock, p.m., Monday, 30th August, 1909, for construction of reinforced concrete bridge over the River Otonabee. E. A. Hay, city engineer.

TORONTO.—Tenders will shortly be invited for pole line supplies by this municipality. K. L. Aitken, Electrical Engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Tuesday, Sept. 7th, for 15 tons of copper conductor. (Advertised in the Canadian Engineer).

TORONTO.—Tenders are invited until Tuesday, Sept. 7th, for construction of asphalt, vitrified block, brick and bitulithic pavements, concrete curbs, concrete walks and sewers. Joseph Oliver, mayor. C. H. Rust, City Engineer.

GODERICH.—Tenders will be received up to noon of August 31st, for the erection of a nine-roomed public school, in the town of Goderich. Plans and specifications may be seen at the office of A. J. Barclay, architect, Crown Life Building, Toronto, or A. D. McLean's clothing store, The Square, Goderich.

TORONTO.—Tenders will be received up to 12 o'clock noon on Monday, August 23rd, for Bridges and Culverts on the wagon road from the Montreal River at Smyth to Gowganda as follows: One bridge at Lost Lake, 290 feet long, with approaches. Two bridges at Long Point Lake, 25 feet long, with approaches. Four bridges between Lost and Leroy Lakes, 25 feet long, with approaches. Two bridges at Miller Creek, 25 feet long, with approaches. About 400 feet of side hill bridging near Lost Lake. And about 45 culverts. The work is to be completed by the first of October, 1909. Plans and specifications and tender forms may be seen at the office of C. H. Fullerton, Engineer, New Liskeard, or F. Cochrane, Acting Minister of Public Works.

TORONTO.—Tenders will be received until Thursday, October 14, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 14, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

AMULREE.—Tenders will be received up to Friday, August 27, for the $3,695.40 debentures for drainage works. J. D. Fisher, Township Clerk, Amulree P.O., Ont.

ORILLIA.—Tenders will be received until 8 p.m. Thursday, September 9, for constructing the following works: Contract "A," Sanitary Sewers, about 15,000 lineal feet. Contract "B," Sewage Pumping Station. Contract "G," Sewage Pumping Machinery. Contract "O," Force Main, about 7,000 feet iron pipe. W. C. Goffatt, Mayor, Orillia. Willis Chipman, C.E., chief engineer, Toronto, Ont.

TORONTO.—Tenders will be received until Monday, October 4th, for erecting the Wilton Avenue Bridge. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Tuesday, 5th October, for 1,080 lengths of 16-inch cast iron pipe and 16-inch valves. Joseph Oliver, mayor. C. H. Rust, city engineer. (Advertised in the Canadian Engineer.)

CORNWALL.—Tenders for alterations to entrance doors, etc., Cornwall, Ont., public building, will be received until Wednesday, September 1. Robert Conroy, caretaker, Public Building, Cornwall. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**Manitoba.**

ROBLIN.—Tenders will be received for material of steel bridge. Plans may be seen at Department of Public Works, Winnipeg. J. P. McKibbin, Reeve of Roblin Municipality.

WINNIPEG.—Tenders for the necessary work on sewage disposal and a water supply for the Sanitorium at Ninette, will be received up to Saturday, August 28. Plans and specifications can be seen at the Municipal Commissioner's Office, in the Parliament Buildings, Winnipeg, or upon application to David Marshall, architect, Brandon. E. M. Wood, Secretary Manitoba Sanatorium for Consumptives.

**Saskatchewan.**

SASKATOON.—Tenders will be received until Wednesday, September 22nd, for the construction of a subway under the tracks of the C.N. Ry. here. Geo. T. Clark, City Engineer. J. H. Trusdale, City Clerk. (Advertised in The Canadian Engineer).

WEYBURN. — Tenders will be received until Monday, August 30, for the following sections of proposed system of waterworks: Contract "B"—Pump house and pump well. Contract "G"—Pumping machinery (power pump and oil engine.) Contract "O"—Mechanical filters, capacity 500,000 gallons daily. Each of these contracts to be completed before November 30, 1909. Plans and specifications for "B" and "G" on file at the office of the Chief Engineer, Room 47, Canada Life Building, Winnipeg, or 103 Bay street, Toronto, also at Weyburn. Geo. Ross, secretary-treasurer, Weyburn. Willis Chipman, C.E., 103 Bay street, Toronto.

**British Columbia.**

VANCOUVER.—Tenders will be received up to Monday, September 6th, for grading and bridging of the Alberni branch of the Esquimalt and Nanaimo Railway Company from the 108th mile to Alberni (27½ miles). See Mr. Bainbridge, Division Engineer E. & N. Railway, Victoria; Mr. H. J. Cambie, Chief Engineer, E. & N. Railway, Vancouver, for plans, etc. R. Marpole, vice-president.

VICTORIA.—Tenders are invited until September 15 for the supply of about nine hundred tons of cast iron socket pipes and special castings. T. Lubbe, secretary, Esquimalt Waterworks Company.

## CONTRACTS AWARDED.

**Quebec.**

MONTREAL.—The department of marine and fisheries has awarded a contract to Clarence De Sola for a hydrographic survey vessel. She will be built by the Swan Hunter firm of the Tyne, the celebrated builders of the Mauretania and other sea leviathans. The vessel will be twin screw, of a length of 273 feet, and it is to be specially devoted, it is understood, to coast survey work. Both vessel and equipment will represent the best work of their class and will prove an important addition to the Dominion Government survey department. The vessel will be of steel throughout, and will be equipped with engines capable of developing great speed.

QUEBEC.—Two tenders were received for the sale of a steam roller to the city for which $4,000 was recently voted. The tenders were Messrs. Cameron & Co., Montreal, representing the Waterous Engine Works Co., and Messrs. Bosse & Banks, of this city. The tender of Cameron & Co., for a roller of 35,500 pounds for $3,700, was accepted as the lowest and most advantageous.

MONTREAL.—The contract for the cementing of the wading pool in Lafontaine Park was awarded to Mr. A. T. Chagnon, at a price of $1,975. It was by far the lowest tender. The next was $4,290, while the highest was $5,50.

**Ontario.**

BRANTFORD.—The Board of Works met on Saturday to award the contract for paving East Colborne street and Market street. The Bitulithic Co. was the only firm to tender, and their offer will be accepted. The figures for the top dressing are $1.63 per yard, whereas the Colborne street work costs about $2. The city engineer will do the concrete work as follows: Foundation, 50c per yard; curb and gutter, 45c per foot. The paving company's tender is for a five years' guarantee.

KINGSTON.—J. W. Litton has been awarded the contract for excavating for the two new science buildings to be erected on Queen's University grounds, and will begin work next Monday. Power & Son, architects, will not have the plans for the building ready for five weeks. Only the foundations of the buildings will be constructed before the winter arrives.

TORONTO.—Mr. A. L. MacLennan, of Toronto, was awarded the contract for the bridges and culverts of the new waggon road from Elk Lake to Gowganda. There will be 12 bridges in all, which will be distributed as follows: One bridge at Lost Lake, 290 feet long, with approaches; two bridges at Long Point Lake, 25 feet long, with approaches; four bridges between Lost and Leroy Lakes, 25 feet long, with approaches; two bridges at Miller Creek, 25 feet long, with approaches; about 400 feet of sidehill bridging near Lost Lake, and about 45 culverts. The contract price is about $4,000. Mr. MacLennan also had the contract for clearing the route of the new road. The grading is being done by day labor, and he will follow immediately with a gang of men to construct the bridges and culverts, which are to be completed by Oct. 1.

COBALT.—S. F. Whitman, of Toronto, was awarded the contract for building the new Temiskaming & Northern Ontario station at Cobalt. The work will be prosecuted without delay.

OTTAWA.—The tender of the Canadian Oil Company, of Strathan Avenue, Toronto, at 4 8-10 cents per gallon for oil required in laying dust on the streets, was recommended for acceptance.

OTTAWA.—The Gutta Percha and Rubber Co'y., of Toronto, have secured from the City of Ottawa a contract for 2,000 feet of "New Peerless" hose at 95 cents. Other tenders were: Canadian Rubber Co., 90 cents, and Dunlop Rubber Co., 97½ cents.

OTTAWA.—Toms, Bouthillier & Slack, for $13,600, secured the contract for building the new Rideau Ward Fire Hall. Pepin and Caron tendered at $13,950 and August Boshmer $13,765. T. Smith offered to do the steel, iron, masonry, plumbing and heating for $8,495 and R. A. Bingham the carpentry, joining, painting and roofing for $5,200. There were a number of separate tenders for the smaller jobs, but on the whole Toms, Bouthillier and Slack were lowest.

**Saskatchewan.**

REGINA.—Tenders for 22,800 feet of trenching (contract a.) and hauling 1,710 tons 18 inch pipe, laying, caulking, backing and filling the trench (contract b.) were recently opened, from the following firms: McVean & Craig, Moose Jaw, A and B, 58c per ft., or $13,338. City Engineer, machine, A and B, 59 6-10c per ft. City engineer, hand, 68 6-10c per ft. John Brodt, Regina, machine, A and B, 70½c per ft. John Brodt, Regina, hand, A and B, 78c per ft. W. J. Gray, Winnipeg, A and B, 92c per ft. Saskatoon Construction and Engineering Co., A and B, 93c per ft. Murphy Bros., A and B, 94c per ft. F. F. Frey, Toronto, A and B, 94c per ft. Municipal Construction Co., A, 22c per ft. Geo. H. Archibald, Winnipeg A, 27½c per ft. The engineer pointed out with regard to the first mentioned tender that at 58c per ft. the total should be $13,224. The tenders were referred to the Works Committee.

REGINA.—The tender of McVean & Craig, contractors, Moose Jaw, for trenching, hauling pipe, laying and caulking, and backfilling trench for water works new pipe line from compensating basins to city for $13,338, was accepted.

**British Columbia.**

VANCOUVER. — Five miles of concrete walks, for which tenders were recently invited, will be constructed by day labor. Fourteen cents a foot was the figure sent in by the Paterson Lumber Co. and Lawrence & Hull. Palmer Bros., who underbid the present contractors now doing the work, did not bid. The price of the present contract is 12 cents. The cost last year when done by the city was 15.2 cents, including grading.

VICTORIA.—Tenders for cast iron pipe were received from the following: R. P. Rithet & Co., $50,930; W. G. Winterburn, $49,892; Stavely Coal & Iron Company, $49,592; Robertson Godson & Co., Vancouver, $50,131; A. Rickaby, $44,190; Robert Ward & Co., $51,191; R. Angus, $48,969; Findlay, Durham & Brodie, $51,776; M. & L. Samuel Benjamin Company, $54,381.

**United States.**

CINCINNATI, OHIO.—The Cincinnati Southern Railroad has awarded at $125,000 a contract for the removal of 200,000 cubic yards of earth in preparation for construction of a new bridge over the Kentucky River at High Bridge, Ky. The new bridge will be 306 feet above the low water mark, one of the highest in the world.

## FINANCING PUBLIC WORKS.

The following municipalities have recently sold debentures:—

Cobalt, Ont., $100,000, for waterworks.
Morris, Man., $12,000, local improvements.
Sudbury, Ont., $11,800, for waterworks.
Magrath, Alta., $14,000, local improvements.
Clinton, Ont., $51,000, waterworks.
Rivers, Man., $12,000.

**Quebec.**

COATICOOK.—On Monday, August 30, the ratepayers will vote on a by-law to raise money for electric light plant and extensions.

HULL.—By-laws authorizing the borrowing of $115,000 for civic purposes have been ratified.

**Ontario.**

AYLMER.—The proposal to erect a new bridge here at a cost of $55,000 has been rejected.

DUNNVILLE.—The by-law to raise $7,000 for extension of waterworks was defeated.

EXETER.—The by-law granting $22,000 for waterworks was carried by 122 majority.

PRESTON.—Debentures amounting to $32,000 are offered for sale by H. C. Edgar, treasurer of this municipality.

**Saskatchewan.**

YORKTON.—The by-law to raise $30,000 for waterworks extensions carried, only three voting against it.

**Alberta.**

TABER.—The Town Council are asking the ratepayers to support a by-law to raise $55,000 by 20-year debentures for the purpose of the erection and construction of a standpipe, water mains and hydrants.

CALGARY.—By-laws are being advertised for the issue of debentures to the extent of $85,900 for city hall and other purposes.

**British Columbia.**

CRANBROOK.—The ratepayers will take over the waterworks system at a cost of $70,000.

RICHMOND.—A by-law will be introduced to raise $275,000 for waterworks purposes.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—The opening of regular passenger service on the new "Shore Line" of the Canadian Northern Quebec Railway between Quebec and Montreal took place last Sunday, when the first through trains ran from each end. The train from Montreal left the Moreau Street station at 11.30, and was made up entirely of new equipment of the most modern type. The line throughout has been laid in a very substantial manner, with 80-pound rails, and every equipment of a modern railway.

MONTREAL.—By an agreement with the C.P.R. the Canadian Northern has the use of Place Viger Station, and they will run their trains from there to Quebec. In return they give the C.P.R. running rights over their line into the city, thereby saving a steep grade and eleven miles of haul. The C.N.R. began their new short line service Sunday.

**Ontario.**

ST. THOMAS.—The Pere Marquette began the grading on Monday for three tracks to a new coal hoist, which will be erected near the roundhouse. It will be of a different pattern to the former one, and will be of the pocket variety, having four shoots, while the hoist, which was destroyed, possessed but the one.

TORONTO.—The Dominion Railway Commission has ordered the construction of a high level bridge over the railway tracks on Queen Street at the Don, and the cost of the work, which will probably exceed two hundred and fifty thousand dollars, is to be borne on the following percentage basis: City of Toronto, 15; Toronto Street Railway, 15; Canadian Pacific Railway, 35; Canadian Northern Railway, 25, and the Grand Trunk, for the old belt line, 10.

**Manitoba.**

WINNIPEG.—Extensive additions are planned by the Winnipeg Street Railway Co., including a nine-track barn in the north end. The terminals at that point are used jointly by them and the Winnipeg, Selkirk and Lake Winnipeg line.

WINNIPEG.—Dominion Government engineers are at present working on the final location surveys for the Hudson Bay Railway, and it is expected that by January 1st at least 125 miles of the permanent location will have been staked out. Party No. 1, in charge of R. D. Fry, left for The Pas, August 11th, and will proceed to a point forty miles north before beginning work. Mr. Fry took three men from Winnipeg with him and recruited the balance of his party in the north. It was he who carried the preliminary survey to Nelson Harbor, and made the survey of the north of the river there. The second party will leave about September 1st in charge of W. J. Clifford, who returned on Friday last from Fort Churchill, where he made a careful survey of the harbor facilities. He has turned over his field notes to the draughting-room staff, and the maps and plans are now in course of preparation. His party will work from The Pas to Frog Creek.

**British Columbia.**

NEW WESTMINSTER.—The British Columbia Electric Railway Company is preparing to commence the actual laying of steel on the first section of the Chilliwack extension of its line from New Westminster. Monday next will see the work of steel laying commence on the grade of the south side of the Fraser River Bridge. The first section of the Chilliwack line from New Westminster to Abbotsford, a distance of 38 miles, is now graded and ready for the steel. The steel for the first 12 miles, as far as Cloverdale, is at New Westminster. The rails to be laid will weigh 70 pounds to the yard and are about forty feet in length. A new style of track laying machine is being used, which does away with the necessity of handling the rails so much. As each rail weighs about 933 pounds this is an important item. It is estimated that fully sixty working days will be required for the steel to reach Abbotsford, making this well on in November. No wiring will be done on this line until the steel has reached Cloverdale, as all the steel for this part of the line is at New Westminster and will have to be taken out over the completed line. It is pretty certain that the line to Abbotsford will be in operation this year, although it will be late in the autumn before the line is completed.

PRINCE RUPERT.—The Grand Trunk Pacific has awarded to Foley, Welch & Stewart a new contract for the second section east of Prince Rupert. It will be 140 miles from Copper River east to Aldermere. This leaves a gap of less than 500 miles, and contracts for this may be let before the end of the year. The new contract is for approximately $10,000,000. There are several long tunnels, one a half-mile in length. The line will cross the Skeena by a cantilever bridge sixteen miles below Hazeltown.

VANCOUVER.—Chief Western Engineer Hoagland, of the Great Northern, says that the recent surveys of the V.V. & E line from Princeton to Vancouver through Hope Mountains show a westbound grade of a maximum of one per cent., and an eastbound of two per cent., a considerable reduction on former surveys.

PRINCE RUPERT.—The Grand Trunk Pacific has awarded to Foley, Welch & Stewart a new contract for the second section east of Prince Rupert. It will be 140 miles from Copper River east to Aldermere. This leaves a gap of less than 500 miles, and contracts for this may be let before the end of the year. The new contract was for approximately $10,000,000. There are several long tunnels, one half a mile in length. The line will cross the Skeena River by a cantilever bridge sixteen miles below Hazleton.

VANCOUVER.—The location plans of the Howe Sound, Pemberton and Northern Railway, which is now under construction from Squamish Landing to Chee Kee, have been filed to the twenty-mile post. The ultimate destination of the road is Lillooet, on the Fraser.

VICTORIA.—The promoters of the Esquimalt and Barkley Sound Railway are losing no time in acquiring the necessary data preparatory to the building of that much-needed line.

**Foreign.**

CHICAGO, ILL.—The old Union Station in Chicago will be replaced by a $25,000,000 structure, according to announcement made recently. The new building will be erected on plans in harmony with the City Beautiful idea.

GREENSBURG (PA.).—The Pennsylvania Railroad has asked for bids to be tendered on about $1,000,000 worth of

construction and improvement work in and about Greensburg, Pa. The Pennsylvania lines west of Pittsburg and Erie are also planning to spend several million dollars in building double track roads and removing grades.

## SEWERAGE AND WATERWORKS.

**Manitoba.**

PORTAGE LA PRAIRIE.—The water system is now perfect and the service is the best in the history of the city. A new well has been installed at the river, and the railway companies now use water from this well, which is pumped to the power house by a motor. It cost $1,350 to dig the well, and that much or more will be expended in fitting it up with galleries.

## MARKET CONDITIONS.

Montreal, August 25th, 1909.

Conditions in the United States are showing a very decided improvement all along the line. Not only are prices advancing, but furnaces and mills are in receipt of good orders, and many of them are now behind on deliveries. Pig iron prices are now firmer, on a basis of $13.50 per gross ton at Birmingham, for Southern, and $15.25 f.o.b., Valley furnaces, for No. 2 foundry iron, and $16 Valley furnaces, at a minimum, for Bessemer iron. This shows an advance of $1.50 to $2 per ton from the low prices which prevailed last March, and while demand has been less aggressive during the past few days, prices continue firm, with higher figures being asked for future deliveries. As a matter of fact, some furnace interests have withdrawn from the market and are declining to quote for future delivery this year. Some makers are asking $1 advance on present prices for 1901 deliveries. The volume of iron now being made is quite up to the high record of 1907—that is, at the rate of 25,500,000 per year. Last month's production was at the above rate, and this may be exceeded during the present month.

English and Scotch markets are also being influenced by the improved conditions in the United States and here, and the optimistic reports which are the result. Cleveland warrants have shown an advance of 1s. 6d. during the past week and prices have advanced in the Scotch markets by fully 2s. 6d. per ton within the past ten days. Even now, there is an indisposition on the part of Scotch makers to book orders for large quantities at the advance. Stocks of warrants in Connell's stores continue to show an increase, but a slight improvement in trade conditions would soon alter this condition. Prices on finished material have not as yet reflected this advance in London and Scotland, this being due to some extent to the fact that German and Belgian makers continue to quote low figures. Conditions in both Germany and Belgium are very flat, and attractive prices can be had for large lots.

Local conditions are showing a steady improvement, not only in the matter of prices, but in the volume of business done. Many consumers, particularly large ones, have apparently reached the conclusion that the present is the time to buy, and a fair tonnage has recently been booked, particularly for import iron. The Eastern Canadian furnaces are not pushing sales. The furnaces of the Hamilton Steel and Iron Co. are at present out of blast, for repairs, the only furnaces in Canada in a position to offer prompt shipment being the Midland, of the Canada Iron Corporation, the Deseronto furnaces of the Deseronto Iron Co. and the Antikoken furnaces of the Antikoken Iron Co. The latter two are only able to supply special grades of iron. The result is that prices are showing a decidedly upward tendency, asking figures being now fully $1 per ton higher than a month ago. This advance corresponds approximately with the higher figures obtaining in the United States and Scotland. Generally speaking, the foundry trade in Canada is rapidly taking on a much more healthy tone.

The steel trade is also improving and the market is firmer all round, in sympathy with the situation on the other side, where prices are up about 30c.

In manufactured and semi-manufactured goods, the tone of the market is firm and demand is showing some improvement. Price changes are becoming rather more frequent, as will be seen from the list this week, as follows:

**Antimony.**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.90 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 3½ cents extra, or 10c. per bbl. weight.

**Chain.** Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.65; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.9[illegible]; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 13¾ to 14c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¼ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 15c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50; Midland or Hamilton pig is quoted at $20 to $20.50, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron soft, $19.25.

**Lathe.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5— rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32 to 32½c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

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Toronto, August 26th, 1909.

The now almost certain prospect of good crops in the North-West, the general success of Canadian farmers in securing good prices for their products, are reflected in the earnings in other departments of the country's industry. Business of all kinds is more active and prices are in many cases looking up, metal being a notable example. It is regrettable to learn of the disablement, at a time of increased production and very active orders, of one of the furnaces of the Hamilton Iron & Steel Works. The loss which the company must suffer is placed at a high figure.

In Great Britain, the price of iron for future delivery is advancing, and there is greater buoyancy in the trade. In the United States, as we note elsewhere, there is a genuine improvement, not bolstered by special interests.

Toronto finds business active, especially so in the way of house-building, which is in a great danger of being overdone, if not already so. The Industrial Exhibition promises to be a good one this year, and the retail activity will be thereby increased.

An experienced New York observer says there is every appearance of a sound actual revival in business in the iron and steel trade, which may be expected to grow and spread to other lines. "With the tariff now out of the way, and a bumper crop promised, basic conditions are now sound and promising.". If, it is added, a reduction should come in the shape of a decline from the extravagant prices to which some securities have been forced in Wall Street, it would make very little impression on the generally favorable mercantile position and prospects in the U. S.

In harmony with this prediction of greater general activity, is the appearance of a circular from an important shipping house to its Canadian clients, dated 24th August, which says:

"We beg to advise that there is a serious car shortage impending which the railroad people now regard as certain between the present time and the coming winter, and we inform you of this so you may anticipate your requirements in our line as much as possible, sending in your specifications for immediate and future shipment."

When it is remembered that hundreds of thousands of cars were reported lying idle only a month or two ago, the significance of the announcement is great.

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

"ORB" and "REDCLIFFE"

Corrugated Iron

Well Galvanized, soft, uniform in weight

John Lysaght, Limited
Makers, Bristol

A. C. Leslie & Co., Ltd.
Montreal

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Season over, nothing doing.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Scbaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, and sales have been made within the month at 5c. less than this. Until the consumption increases, prices will not improve. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

**Detonater Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $2.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14 gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15; 10¾, $4.50 per 100 lbs. Fleur de Lis—gauge, $4.50; 26-gauge, $4.25; per 10 lbs. This downward change is the result of dissolution of an agreement between Britisb and U. S. makers. Impossible to say how long it will last.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Talk is still heard of an advance, but nothing definite.

**Lead.**—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—The local demand for stuff is maintained, but there is not so much doing outside. Southern pine continues to move, and the stock on hand is depleted. Spruce flooring is not so much heard of here, since better prices can now be had for spruce at home in New Brunswick and Quebec. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $2.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer braod, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots $2.05.

**Ready Roofing.**—More demand during the past few days, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. lung | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44. 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and we quote an advance of ½c., say 31½c. to 32c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $31.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked. $1.90 to $2.

syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, new, 6 to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, 7½ to 9c.; fancy, 11 to 12c.; extra fancy, 14½ to 15c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Now quite scarce. Tierces, 14½c.; tub, 14¾c.; pails, 15c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Short cut, $25 to $26 per barrel; mess, $23.50.

**Potatoes.**—Ontario, old, 75 to 90c. per bag in car lots on track.

**Rice.**—B grade, 3¼c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 13¾c. to 14c.; firm, tons and cases; hams, large, 13 to 14c.; small, 15½ to 16c.; rolls, 13 to 13½c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pick'e, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.75 per 100 lbs. in barrels; Acadia, $4.65; yellow, $4.35; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 18 to 35c .per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, August 24th, 1909.

As stated last week country orders are exceptionally quiet. The repair shops and implement men are doing a rushing business. Harvest is in full swing all over the west and a bountiful crop is being reaped. Locally the dealers in builders' supplies continue to be kept very busy filling orders, as are also the local iron working shops. The Dominion Bridge Co. are this year more than doubling their capacity, and the Manitoba Bridge & Iron Works have also greatly enlarged their plant, and are now able to take care of the largest bridge work required in the West. Both these firms are working up to the limit keeping pace with the steel buildings being erected in Winnipeg and other large centres. Quotations on beams and channels remain steady, there being scarcely any variation on this market. Railway supply firms report business to be quiet, but most of them have had a fairly good season. One dealer in cement brick machines and other concrete machinery called on last week, reported to have done a good business in the West this year in the lines that he handled.

All quotations on the Winnipeg market are firm and are as follows:—

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy

Cement is again somewhat quiet and prices are pared down very low. A good demand is also noted for a better class of brick this season.

Winnipeg quotations are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in. $55; cull red or white pine or spruce $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft. $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 50c.; No. 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winni-

Approach to Huntley Street Bridge, Rosedale, Toronto, treated with "VULCAN FLUID ASPHALT" under direction of City Engineer, Roadway Department.

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A manufactured product carrying Asphalt in solution—entirely free from all the objectionable features of Crude Oil—sanitary and wholesome—a road builder—after one application roads remain dustless for a year or longer. We invite inspection of this product where it has been used on the streets of Toronto—**"the proof of the pudding is in the eating."** We guarantee it. Call and see us. Send for booklet.

## The British American Oil Co., Limited

Offices 6 KING WEST Refiners - TORONTO, ONT.

"That obtained from The British American Oil Co., I think, is the preferable oil"—Dr. Sheard on Road Oil in "Canadian Engineer," July 16th, 1909.


peg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $8 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coppered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; 5/8-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hair.**—Plaster's, 80 to 90 cents per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4½c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.00.

**Picks.**—Clay, $5 dozen; pick mattocks, $6 per dozen; elevisbes, 7c. per lb.

**Pipe.**—Iron, black, per 100 feet. ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.15; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6¼c. per lb.

**Pitch.**—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¾c.; British Manila, 11¾c.; sisal, 10½c.

**Spikes.**—Basis as follows:—1¼ x 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.10 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 100 lbs.

**Timber.**—Rough, 8 x 8 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Tool Steel.**—8½ to 15c. per pound.

**Wire.**—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 gauge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.

### PATENT NOTICE.

Notice is hereby given in regard to Canadian patent No. 100,980, Caulking Strip for Steam Turbines, granted Sept. 11, 1906, that Allis-Chalmers-Bullock, Ltd., Montreal, owners of rights under said patent, is prepared to supply devices covered by this patent.


### PATENT NOTICE.

We manufacture for sale and on order **Pumps** and **Pumping Engines** for liquids, air and gas, **Condensers, Cooling Towers,** and other apparatus and machinery under all Canadian Letters Patent, owned or controlled by the International Steam Pump Co. and its companies, including the following patents:—

| | | | | | |
|---|---|---|---|---|---|
| 47168 | 52155 | 53620 | 62005 | 70612 | 73076 |
| 74310 | 75069 | 75359 | 76510 | 76520 | 77066 |
| 77655 | 79001 | 80482 | 81034 | 82040 | 82041 |
| 84108 | 84109 | 86288 | 86516 | 86517 | 89098 |
| 89241 | 89242 | 90262 | 90263 | 91475 | 92382 |
| 92383 | 92384 | 92385 | 91475 | 94474 | 95400 |
| 95401 | 95608 | 98190 | 98741 | 99074 | 99790 |
| 100361 | 100910 | 101065 | 104046 | 107474 | 107857 |
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# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, SEPTEMBER 3rd, 1909. No. 10

## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

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**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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**NOTICE TO ADVERTISERS**

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TORONTO, CANADA, SEPTEMBER 3, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## THE BEHAVIOUR OF DUCTILE MATERIAL UNDER TORSIONAL STRAIN.

A very interesting paper on this subject was read at the Winnipeg meeting of the British Association for the Advancement of Science by Mr. C. E. Larard, M. I. Mech. E.

The experiments were carried on at the Northampton Institute, London, Eng., and the material used varied in size from half an inch to three inches, and consisted of Staffordshire wrought iron, mild steel, and an alloy steel containing about three per cent. nickel.

Some of the results obtained are of peculiar interest, because they are different to what was expected.

It was found that there was not, in ductile material, a well-marked yield-point for torsion as there is for tension.

It was also found that when maximum torque is reached failure takes place by shear, the shear commencing on the surface of the specimen and extending inwards.

For homogeneous materials the work done is found to be proportional to the volume, no matter what the diameter or length.

The elastic limit and the elastic resilience of material may be raised above the primary limit, which is purely an artficial one, produced by manufacturing operations, by (a) overstraining, with full recovery of elasticity to a higher limit by heat treatment at low temperatures. (b) By indefinitely long rest after overstraining. (c) By continuous stressing of material at a fairly constant load above the primary elastic limit. (d) In manufacturers' works by scientific straining with subsequent heat treatment. (e) Considering the forms of iron and steel, by the addition of a small percentage of some other element. Any one of these methods increases the ratio of elastic limit to maximum load, and the ratio of elastic resilience to the total work which has to be done on the specimen to destroy it.

A comparison of the results of the tests on wrought iron and steel shows the great superiority of steel as compared with wrought iron for shafting.

As a practical outcome of these experiments Mr. Larard drafted a set of specifications for torsion tests.

## THE TELEPHONE AND ITS SERVICE.

Next week the Canadian Independent Telephone Association will meet in Toronto. The problems of the independent companies are just as vital as they ever were. The difficulty of arranging exchange of messages, long distance messages, and of maintaining a highly efficient line at low cost and without excessive capital expenditure is still a question with them.

The number of independent companies is increasing, and the number of Bell-controlled companies is also increasing.

Canada and the United States have now over 6,500,000 telephone stations, operated by 24,000 companies. The Bell system control 32 companies and 3,215,245 stations.

The telephone and its service has become such a part of our everyday and business life that we sometimes

forget these companies have grown up within the last thirty years. And the end is not yet.

The number of companies and the number of new stations is growing steadily. The business is being placed upon a more permanent basis than formerly. Users and companies are co-operating, and the number of stations and miles of line are almost sure to double within the next five years.

## CONSERVATION OF NATURAL RESOURCES.

The last session of the Dominion Parliament authorized the appointment of a Commission on Natural Resources. That Commission has been appointed, and its personnel will meet with general approval.

The Commission will investigate, report and make recommendations, and the chairman, Hon. Clifford Sifton, will be the administrative head, and will be expected to see to the enforcing of the Commission's wishes.

The establishing of this Commission should lead to practical and immensely valuable results. A policy of conservation and utilization of our natural resources will be worked out and a permanent organization will, under governmental direction, give continuity and purpose to these plans.

The industrial and commercial prosperity of Canada depends on the conservation and utilization of Canada's natural resources; and it is well that the matter is receiving such attention.

## EDITORIAL NOTE.

The value of the mineral output of British Columbia last year showed a decline. This was expected, since the price of metal was low in 1908. The figures are: 1907, $25,882,560, and 1908, $23,851,277.

## CANADIAN TELEPHONE ASSOCIATION.

The third annual convention of the Canadian Independent Telephone Association, will take place in the City Hall, Toronto, on Wednesday, September 8th next, at 10 a.m. sharp.

The programme is as follows:—10 a.m., meeting called to order; address of welcome; reports.

Papers and addresses.—Independent Telephone Situation in Canada, by F. Dagger, Dr. Demers, T. R. Mayberry, M.L.A. Is the Telephone a Natural Monopoly? by F. Dagger. Good Construction. Proper Rates for Rural Service. Collections. Independent Telephones in Railway Stations, by C. Skinner. Exchange Directory, by Dr. Doan. Reasonable Toll Connection Relations. Good Operating. Forced Physical Connection.

## THE AMERICAN MUNICIPALITIES CONVENTION.

The thirteenth annual convention of the League of American Municipalities opened in the Windsor Hotel, Montreal, Aug. 25th, under the presidency of the Hon. Silas Cook, Mayor of East St. Louis, Ill. About five hundred delegates and friends were present.

In the absence, through ill health, of Mayor Payette, the visiting delegates were welcomed to Montreal by Ald. Sadler, who, during discussion, defended the city against the imputation that it has the highest taxes in America.

The president, in his address, said the people at large did not know enough about the internal workings of their own city government. His experience convinced him that the first step towards exalting municipal conditions was to take the public into the governing body's confidence.

Mr. John McVicar, the secretary, claimed that the hand of the League was shown in the improvement in municipal bookkeeping, civic annual reports and the extension of practical civil service.

Mr. Thomas J. Crittenden, Mayor of Kansas City, said he believed what was most needed was uniformity in civic affairs. He made a plea for lenient dealing with the drunkard and the youthful offender.

Dr. W. H. Atherton described the aims of the City Improvement League, which was, he said, designed to unite the efforts of all citizens seeking to make Montreal cleaner, healthier, more comfortable and more attractive. Their programme included a campaign of education, the teaching of citizenship to the young, and the formation of a federation of boys' clubs, with the view of making them realise the importance of public spirit.

## PRESIDENTIAL ADDRESS.

(Continued from page 272.)

siderable risks if they think that silence is beneficial to their business interests. Even if it were true that in the earliest applications of the new system economic results had not been obtained equal to those realized in reciprocating engines which have been gradually improved during half a century, that circumstances should not be regarded as a bar to acceptance of a type of engine that admittedly possesses very great advantages in other ways, but should be regarded as an incentive to improvements that would secure greater economy of coal. The evidence available, however, does not confirm the adverse view, and those familiar with the facts do not admit its truth. One example may be cited as it affects the Canadian service. In June 1907 it was authoritatively stated that in the Allan Liner "Virginian" the reports which had been circulated respecting the excessive coal consumption were unfounded, that the vessel was making passages at speeds of 17⅝ to 17¾ knots, as against the 17 knots estimated, and the rate of coal consumption was really about 1.4 lbs. per indicated horsepower which would have been required to attain this speed if the vessel had been fitted with reciprocating engines. This result compares well with the consumption in ordinary passenger steamers running at high speeds in proportion to their dimensions, although in large cargo steamers and vessels of the intermediate type, working under much easier conditions and at very low speeds, in proportion to dimensions, lower rates of consumption may be obtained. With these latter vessels the fair comparison is the combination system and not the pure turbine type which is adapted for high speeds.

The crowning triumph of the marine steam turbine up to the present time is to be found in the great Cunard steamships "Lusitania" and "Mauretania." The passages made this year by the latter ship since she was refitted have been marvellously regular, and the 25 knots average across the Atlantic, which was the maximum contemplated in the agreement between the Government and the Cunard Company, has been continuously exceeded. As one intimately concerned with the design of the "Mauretania," who has had large experience in ship design, has made a life-long study of the laws of steamship performance, and had the honour of serving on the committee which recommended the employment of turbines in these great ships, the writer ventures to assert that equal results could not possibly have been obtained with reciprocating engines in vessels of the same form and dimensions. Contrary opinons have been expressed, but they have been either based upon incorrect data or have omitted consideration of the fact that in vessels of such great engine-power it was necessary to have time to perfect the organization of the staff in order to secure uniform conditions of stoking and steamp roduction, and to bring the "human element" into a condition which would ensure the highest degree of efficiency in working the propelling apparatus. This necessity for time and training has been illustrated again and again in the case of new types of Transatlantic steamers, including some which held the record for speed prior to the

appearance of the Cunarders. In the "Lusitania" and "Mauretania" the engine-power is fully 60 per cent. greater than that of their swiftest predecessors, yet no similar allowance appears to have been thought necessary by some critics, who assumed that performances on the earlier voyages represented the maximum capabilities of the vessels. Subsequent events have shown this view to be fallacious and have justified the recommendation of the Turbine Committee and the action of the Cunard directors. Allegations made in regard to excessive coal consumption have also been disproved by experience; and in this respect the anticipations of the committee and of Mr. Parsons have been fully realized.

The marvellous regularity maintained by the "Mauretania" on a long sequence of consecutive Transatlantic passages—made under varying and in many cases very adverse conditions of wind and weather, and sea—illustrates once more, and on an unprecedented scale, the influence which large dimensions have upon the power of maintaining speed at sea. Starting from the eastward passage, beginning on February 3rd last, and taking twelve passages (westward and eastward) which followed, the average speed for the thirteen passages, approaching 40,000 sea miles in length, has been 25½ knots; the lowest average speed in the series has been 25.2 knots, the highest average speed 25.88 knots. Many of the winter passages in this series were made in winter weather against strong winds and high seas, which would have considerably reduced the speed of her predecessor, but had small influence on the "Mauretania." In many instances delays have been caused by fogs.

On seven consecutive passages made since the beginning of last May the average speed of the "Mauretania" in covering about 20,000 sea-miles has been 25.68 knots, the minimum speed for the passage having been 25.62 knots and the maximum 25.88 knots. On her contract trials, the "Mauretania" maintained an average speed of 26.04 knots for a distance somewhat exceeding 1,200 knots, the steaming time being rather less than forty-eight hours. On the passage when she averaged 25.88 knots, she ran 1,215 knots from noon on June 17 to noon on June 19 (about forty-six hours), at an average speed of 26.23 knots, and by noon on the 20th had covered 1,817 knots at an average speed of 26.18 knots for sixty-nine hours. The ship has, therefore, surpassed on service her performance on the contract trial.

In view of the foregoing facts and of others of a similar nature, it is reasonable to assume that as experience is enlarged and information is accumulated in regard to forms of propellers likely to prove most efficient in association with quick-running turbines, sensibly improved performances will be obtained. At present, in comparisons made between the efficiency of reciprocating-engined ships and turbine-engined ships, the former have the great advantage attaching to long use and extended experiment; but this is not a permanent advantage, and it may be expected that good as the position is to which the marine steam turbine has attained in the brief period it has been in practical use, that position will be gradually improved. Whether or not other forms of propelling apparatus in their turn will surpass the steam turbine it would be unwise to predict. Internal combustion engines are regarded in some quarters as dangerous and probably successful rivals to steam turbines in the near future. Within certain limts of size, internal combustion engines no doubt answer admirably; but as dimensions and individual power of the engines are increased, the difficulties to be overcome also rapidly increase, and the fact is fully recognized by those having the best knowledge of those types of prime movers. On the whole, therefore, it seems probable that the turbine will not soon be displaced, whatever may happen eventually.

All branches of engineering have been and will be drawn upon freely in the execution of this great task. Mining and metallurgy assist by the production of materials of construction; mechanical and electrical engineers contribute machines and appliances required in shipyards and engine factories, as well as guns, gun-mountings, and mechanical apparatus of all kinds required in modern warships in order to supplement and economize manual power; marine engineers design and construct the propelling apparatus, and constantly endeavour to reduce the proportion of weight and space to power developed; naval architects design and build the ships; constructional engineers are occupied in the provision of docks, harbours, and bases adapted to the requirements of the fleet; and other branches of engineering play important, if less prominent parts. The progress of invention and discovery is increasing, rapid changes occur unceasingly, the outlay is enormous, the task is never ending, but its performance is essential to the continued well being of the Empire, and it must and will be performed.

## PERSONAL.

MR. T. A. FRANCOMBE of Windsor, has received the appointment as chief engineer of the Gilchrist Transportation Company, who maintain and operate the largest fleet of boats on the great lakes, next to the United States Steel Corporation. Mr. Francombe has been with the Gilchrist Line for ten years.

MR. WYN MEREDITH, an electrical engineer of high repute, who supervised the construction of the Coquitlam dam and the big power plant at Lake Buntzen, has arrived in Victoria, having been engaged by the B. C. Electric Railway & Lighting Company to construct their contemplated works at Jordan river.

MR. R. R. KELLY, M. Can. Soc. C.E., and formerly city engineer of Edmonton, Alta., has been appointed Professor of Electric Engineering in the Nova Scotia Technical College, Halifax.

MR. C. H. MITCHELL, of Messrs. C. H. and P. H. Mitchell, consulting engineers, Toronto, has just left for Prince Albert, Sask., where he will report on a power plant.

MR. J. A. McLARDY, St. Thomas, Ont., for some years trainmaster of the G.T.R.-Wabash, has been appointed trainmaster of the G.T.R. at Stratford, to succeed Trainmaster Bowker, going to London as superintendent.

## FREE ENGINEERING ADVICE.

Sir,—Most municipal engineers spend a great deal of time in answering enquiries on engineering subjects. The following reply might be considered as a standard but it would be interesting to know the opinion of other engineers on this question.

Yours,

T. S. Scott.

Toronto, September, 1909.

Dear Sir,—I have your recent enquiry, and am sorry to say that similar enquiries are so numerous that I have recently decided that my department will furnish information as a matter of professional courtesy to properly accredited engineers, and to them only.

I find that in many cases gratuitous information is used either to confute local engineers under quite different local conditions, or to altogether avoid paying for the services of local engineers.

Visiting or corresponding engineers will be treated with every courtesy and information gladly given. Other enquirers will, in future, be answered on the written understanding that services are to be paid for and a professional estimate or opinion will be furnished when asked for on that basis. It should be remembered that my time and that of my subordinates, in office hours, belongs to the City of ..... and not to other municipalities. Our time after office hours we are entitled to devote, within certain limits, to outside professional work, but feel that engineering advice should be paid for in quite the same way as legal and medical advice.

Yours truly,

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Aug. 28 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Aug. 27 '08 | Price Aug. 20 '09 | Price Aug. 27 '09 | Sales Week End'd Aug27 | Price Aug 27 '08 | Price Aug. 20 09 | Price Aug. 27 '09 | Sales Week End'd Aug27 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | | | 177 | | 184¼ | 350 | 176¼ | 176½ | 186 | 185 930 |
| Canadian Northern Railway | 2,986.9 | | | | | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | | | | | *1st. pref. 107½, 3rd pref. 58⅜, ordinary 24¼ | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | | | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 80 013 | 71,335 | | | | | 180 | 178½ | 213 | 212½ 30 |
| Toronto Street Railway | 114 | 8,000 | 100 | 77,434 | 68,556 | | | 124½ 123 | 88 | 165½ | 165 | 124⅜ | 124 229 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 167 | 165½ | 190 187 | 2 | | | | 186 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## STEAM RAILWAY EARNINGS.

At the time of going to press, the earnings of the steam railroads for the last week in August are not to hand, as the figures for the last day have to be included. They will be published in our next issue.

## RAILWAY EARNINGS.

Total gross earnings of United States railroads reporting for the three weeks of August, are $17,186,996, an increase of 10.8 per cent, over last year and a loss of only 1.4 per cent. compared with the corresponding period in 1907. Considerable gains are reported by a number of roads over a year ago, and the small loss compared with 1907 shows how nearly railroad traffic is back to normal. In the following table is given earnings of United States roads reporting for the three weeks of August and the same roads for a like period in July; also the more complete reports for July and the two preceding months.

| | Gross Earnings 1909. | Gain. | Per Cent. |
|---|---|---|---|
| August, 3 weeks | $17,186,996 | $1,669,364 | 10.8 |
| July, 3 weeks | 19,909,497 | 979,028 | 5.2 |
| July | 51,929,280 | 4,248,856 | 8.9 |
| June | 53,640,787 | 5,695,673 | 11.9 |
| May | 52,641,574 | 6,934,543 | 15.2 |

Total gross earnings of United States roads included in the classified statement for July, are $51,929,280, an increase of 8.9 per cent. over last year. All classes of roads contribute to the increase, Eastern Trunk lines and other Eastern roads showing considerable gains. The statement is printed below:—

| July— | Gross Earnings 1909. | Gain. | Per Cent. |
|---|---|---|---|
| Trunk East | $ 6,950,872 | $1,228,767 | 21.4 |
| Trunk, West | 5,707,005 | 308,914 | 5.7 |
| Other Eastern | 823,510 | 150,881 | 22.1 |
| Central West | 6,264,183 | 294,905 | 4.9 |
| Granger | 1,711,950 | 133,151 | 8.4 |
| Southern | 13,324,467 | 586,344 | 4.8 |
| Southwestern | 17,147,293 | 1,545,894 | 9.9 |
| United States roads | $51,929,280 | $4,248,856 | 8.9 |
| Canadian | 7,004,000 | 808,000 | 13.0 |
| Mexican | 4,422,621 | 209,000 | 4.9 |
| Total | $63,355,901 | $5,265,856 | 9.1 |

—Dun's Review.

## MONTREAL STREET RAILWAY

Month of July.

| | 1909. | 1908. | Increase. Amount. | P.C. |
|---|---|---|---|---|
| Passenger earn. | $334,237.57 | $313,353.20 | $20,884.37 | 6.66 |
| Miscell'us earn. | 11,335.99 | 13,171.19 | *1,835.20 | *13.93 |
| Total earn. | $345,573.56 | $326,524.59 | $19,049.17 | 5.84 |
| Operating exp'es | 180,412.11 | 162,413.90 | 17,998.21 | 11.08 |
| Net earn.... | $165,161.45 | $164,110.49 | $ 1,050.95 | .64 |
| Total chrgs. | $ 49,883.51 | $ 49,344.99 | $ 538.52 | 1.09 |
| Exp's % of earn. | 52.21 | 49.74 | ..... | 2.47 |

October 1st to date—ten months.

| | 1909. | 1908. | Increase. Amount. | P.C. |
|---|---|---|---|---|
| Passenger earn. | $3,064,270.17 | $2,939,601.00 | $124,669.17 | 4.24 |
| Miscell'us earn. | 73,276.66 | 59,686.92 | 13,589.74 | 22.77 |
| Total earn. | 3,137,546.83 | $2,999,287.92 | $138,258.91 | 4.61 |
| Operating exp's | 1,894,815.41 | 1,814,428.44 | 80,386.97 | 4.43 |
| Net earn... | $1,242,731.42 | $1,184,859.48 | $ 57,871.94 | 4.88 |
| Total chrgs. | $ 359,774.71 | $ 368,908.56 | *$9,133.85 | *2.48 |
| Exp's % of earn. | 60.39 | 60.50 | ..... | *.11 |

*Decrease.

## C. P. R.'S NET GAIN MONTH OF JULY

Canadian Pacific Railway Company's statement of earnings and expenses for the month of July:

| | |
|---|---|
| Gross earnings | $7,140,029.03 |
| Working expenses | 4,660,159.20 |
| Net profits | $2,479,870.73 |

In July, 1908, the net profits were $2,274,573.25. The gain in net profits over the same period last year is, therefore, for July, $205,297.48.

## RAILWAYS—STEAM AND ELECTRIC.

**Ontario.**

TORONTO.—The freight yards of the G.T.R. have been moved from York to Mimico, 13 miles, with the object of saving time and equalizing the work as it affects employees.

**Alberta.**

CALGARY.—Fourth avenue is being torn up preparatory to having the rails for the street railway laid from Centre street to 4th street east.

CALGARY.—The C.N.R. and the G.T.P. are having a speed contest in the line of railway construction from the main line of both railroads to Calgary. Seventy-five miles of railroad grading completed within six weeks of the day of starting is the record of the contractors on the Vegreville to Calgary branch of the C.N.R. The steel has been laid to within half a mile of Ryley where work had to temporarily cease owing to lack of rails at that point. The graders are hard at work between Ryley and the Battle River which is six miles south of Camrose. South of the river the most of the work is done for thirty miles and a few days will see all the gaps closed up to within twenty miles of Stettler.

EDMONTON.—The C.P.R. have proposed that the city unite with the railway in the construction of a combined traffic and railway bridge over the river at a cost of $1,428,793. A railway bridge alone would cost $842,727. The structure exclusive of approaches, would be 2,687 feet long, 25 feet wide, and 2,953 feet above water level.

THE
# Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWAGE DISPOSAL.

### Removal of Putrescibility.

With reference to the cost of land intermittent filtration, this necessarily varies considerably, depending on many local conditions. The cost of the land, the suitability of the grade are chief factors. The Royal Commission have to say: "Assuming that really suitable land can be purchased at $500 per acre, land treatment of sewage is probably cheaper than artificial biological filtration, but when the soil is not suitable and on which only a comparatively small volume of sewage can be treated per acre, the cost of land treatment would probably be greater than most of the artificial processes." The Commission give the following comparative figures of cost, comparing cheap suitable land filtration with percolating biological filtration: Intermittent filtration with little cropping at $0.14 per head of population drained as against $0.25 for percolating biological filters. In Germany the cost of land treatment varies from $40 to $150 per acre, viz., for preparing and laying out the land and tank construction works. The total cost for preparing the land at the Berlin and Breslau farms, however, ran to $200 per acre. The Framingham, Mass., works cost at the rate of $600 per acre, utilized apart from pumping plant; while the Brooklin works cost at the rate of $470 per acre utilized.

Referring again to the Royal Commission some instructive figures are given of the cost of land intermittent filtration, assuming a good soil and little cropping subservient to purification.

Total area of land required to treat a dry weather flow of one million gallons at the rate of an acre to each 25,000 gallons:

| | |
|---|---|
| Forty acres of land at $500 per acre..... | $20,000 |
| Five acres for sludge disposal, per acre.... | 2,500 |
| Cost of laying out land, including levelling, grading, underdrains, carriers, etc.... | 22,445 |
| Cost of settling tanks ..... | 11,150 |
| Total cost ..... | $56,095 |

The above figures work out at a rate of $1,240 per acre.

It will at once be seen that no definite figures can be given for land intermittent filtration. It is possible at times to obtain just the kind of land suitable which is naturally so graded, that practically no levelling is required and very little work of any kind apart from laying the carriers It is in cases of the latter character that it behoves the engineer to give every consideration to the question of land treatment, before adopting any of the artificial methods, which at their very best may equal land intermittent filtration in the removal of putrescibility but cannot equal it in bacterial removal efficiency. Before closing this chapter, stress may again be laid on the great importance of the removal of as great an amount of the suspended solids as possible before the liquor is applied to the land; on this depends the continued success of the filtration and freedom from land pore clogging.

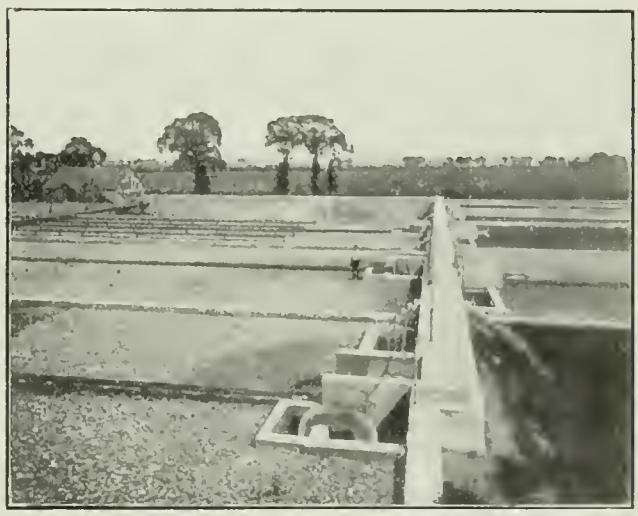
* These articles are specially prepared for this review by Mr. T. Aird Murray, Consulting Engineer, Toronto, Ont.

Chapter IV.

### Contact Beds.

Having reviewed the subject of the removal of putrescibility by means of land intermittent filtration; it is now our purpose to enquire more particularly into artificial structures, which are designed to carry out the same process as that of land, but occupying much less area.

We have seen, that, in order to maintain an equilibrium between the processes of absorption, retention of organic matter and its oxidation or mineralization; that even with ideal sand land, an area is required of about one acre for every 30,000 gallons of sewage treated per day. If this rate is increased, we find, that, gradually the amount of nitrites and nitrates in the effluent decreased, showing a diminution in oxidation and consequent low degree of purification. This



**Croydon Bacteria Beds Adam's & Co., (England), Automatic Syphons.**

means the retention, in the soil pores, of undigested organic matter: which, by gradual accumulation, causes, what is termed sewage sickness in land. The only remedy is a long period of rest, breaking up the land by ploughing and allowing thorough oxidation. The original purifying power of land may thus be restored. Sewage sickness in land is, also, further accelerated by the inability of land, owing to its fine porosity, to pass off a characteristic product in sewage purification of colloidal character These colloids are gelatinous in character; and, although they escape and are are flushed from large grain filters, are retained by land.

We have seen, that, areas of land equal to one acre per 30,000 gallons per day, are not easily obtained of the suitable porous character required. Allowing a water supply per head per day of 60 gallons, this means an acre for each 500 of population, or 20 acres for 10,000 people.

The inability of land to treat sewage at any other but such low rates of filtration, is mainly due to the small size of the particles of material composing the soil. We have seen that soils with a suitable effective size and uniformity co-efficient value have a water retention capacity of about 18 per cent. of the volume occupied by the soil. When the water retaining capacity is deducted from the volume occu-

pied by the pores, we have what is termed air capacity. When a soil has a water retaining capacity almost equal to the volume of the pores, then air capacity almost ceases to exist; and purification or oxidation practically ceases to exist.

Now it must be obvious, that, the greater the effective size and uniformity coefficient value of the filter particles the less becomes the water retaining capacity in proportion to the total volume, and the greater becomes the air retaining capacity in proportion to the water retention volume.

With a low effective size and uniformity coefficient it means, that, a dose of sewage is capable of being held up by capillary attraction in every pore of the filter, and, that, pracically all the air is driven out of the filter.

Now, the greater the supply of oxygen throughout a filter, the greater is its efficiency, therefore, the higher the effective size and uniformity, coefficient of the material, the greater becomes the volume of oxygen, which the filter is capable of retaining. There must, however, be practical limits to the increase in the size of the filter particles, as it has been shown that it is not only a question of oxidation (or nitrification); but, it is a question of the ability of the filter to retain and hold up, within itself, matter in suspension, as well as absorb from the sewage organic matter in solution. These matters are not oxidized even after they have been retained, or absorbed, in the space of a few minutes, or even of a day. The oxidizing process of nitrification is no sudden effect, but intricate and prolonged.

How can the difficulty be got over? We must have a filter, the air retention capacity of which is high with a consequent low water retention capacity; and yet, it must be possible to retain within the filter pores practically the whole of the organic matter both in suspension and solution, until such time as they are fully acted upon by the process of nitrification, so that the effluent will show not albuminoid ammonia but its oxidized equivalents of nitrites and nitrates.

It was very early shown that the purifying process in sewage by land was not due to any peculiarly inherent attributes of soil; nor, was the purifying process due to any plant life grown on the soil surface; as plant life has no use for the organic compounds contained in sewage until they are mineralized or oxidized. Filters composed of pebbles, stone, or, in fact, most hard material in cubes, were found to be as effective in purifying sewage as soil. The whole problem became, therefore, one of substituting some other filtering material, rather than soil; the latter providing too small an air retaining capacity in proportion to its water retaining capacity. With the water carriage system, the total amount of sewage proper as compared with the volume of water is small. By substituting a material which will retain within itself sufficient oxygen to treat the sewage and yet pass off the large volume of water at high rates is the problem of artificial treatment.

The earliest experiments in the above lines which were carried out in England were in connection with the London County Council. The Massachusetts observations and results were the basis of the experiments; which, were conducted with settled London sewage at Barking. The work was under the direction of Santo Crinip (engineer to the County Council) and Mr. Dibden (chemist). The first experiments in 1890 were conducted with four tanks giving a superficial area of 1-200 acre. The tanks were respectively filled with coke breeze, sand and gravel, stones and burnt clay of the size of peas. These tanks were filled with sewage, which was allowed to stand for eight hours, so as to give ample opportunity, as was thought, for nitrification to take place. The sewage was then drawn off, and air allowed to take its place in the filter. During the three months that these tanks were in operation, non-putrescible effluents were obtained. The results being considered, so far satisfactory; an experiment was commenced in 1892 with a larger filter, an acre in area and 3 feet 3 inches deep, of 3 feet coke breeze and 3 inches gravel on top. This filter, at first, was not a success. It was operated precisely as the smaller tanks had been, viz., an eight hours period, standing full of sewage, followed by a period for oxidation or rest. After six weeks the effluents showed a diminution of nitrates and nitrites. In fact, the filter became clogged, the sewage standing on the surface; clearly showing, that, an equilibrium between retention, absorption and oxidation had not been obtained. The filter was retaining more matter than it was capable of digesting.

Although, the above were based on the Massachusetts observations, the experiments were not analogous. Intermittency was more frequent at Massachusetts; where, in fact, the sewage was supplied in doses at periods of twenty to thirty minutes. The results, even with the preliminary experiments at Barking never equalled those made in the States. Dibben acknowledged, that, the experiments failed through lack of intermittent treatment, and, because, of a too high rate of filtration; consequently, in 1894, the filter, having recovered after a prolonged period of rest, it was again put in operation, being allowed to stand full for two hours instead of eight. Good results were now obtained. The filter, showing every promise of maintaining an equilibrium, Dibden advised the Sutton authorities, after some preliminary experiments with the sewer there, to adopt the system.

This system, first adopted in 1894 at Sutton, Surrey (England), came to be known as the Contact Bed System. because, of the period of contact allowed, during which the sewage was supposed to undergo purification. An illustration of these beds is given in our issue of August 6th. The beds were alternately filled with and emptied of sewage. The filtering material was composed of coke breeze on the same principle as the London experimental filter. The sewage was successfully treated at a rate of 750,000 gallons per acre per day, with the result, that an oxygen absorbed efficiency of 86.5 per cent. reduction was obtained; the effluents being rendered non-putrescible.

Sutton abandoned, altogether, chemical treatment, and land filtration; and many other towns commenced to follow its example. It was calculated at Sutton, that, 77 tons of sludge were retained in seventy-six days by the biological contact beds, and it was believed, that, this sludge was changed to gas and water and harmless mineral salts.

Contact beds were accepted, for the time, as the final solution to the sewage disposal question. It was argued, on every hand, that, these beds provided perfect homes or workshops in which the nitrifying organisms could carrry out and maintain their work of decomposing and changing the chemical organic combinations in sewage liable to putrescibility. Instead of an acre of ideal land (perhaps impossible to obtain) treating sewage at the rate of 30,000 gallons per day, here was an acre of filter, which could be constructed anywhere, independently of the porosity of the land, capable of treating 750,000 gallons per day, or at twenty-five times the rate on land.

At first, it was the custom to measure contact beds, with reference to rate of treatment, by their superficial area; now, however, all artificial biological methods of filtration are generally measured by their cubic capacity. With land, it was a question of acreage, with tanks enclosing the filtering material at certain depths, lengths and breadths, it is a question of capacity. Accordingly, the Fifth Report of the Royal Commission on Sewage Disposal have departed from the old custom and now use the cubic yard as the unit of measurement of capacity with reference to rate treatment. This applies to both contact beds and percolating filters.

At the time of (and for a considerable time after) the introduction of contact beds at Sutton, it was taken for granted that the period of contact was utilized by bacteria for breaking up the organic compounds in the sewage. The period of rest was looked upon as one of recuperation and for supplying the necessary oxygen required for nitrification. This explanation of the working of a contact bed is, however, not in accordance with recent investigation and knowledge.

It will be apparent to anyone giving a moment's consideration to the matter, in the light of newer knowledge, that, while the contact bed is standing full of sewage, conditions are provided exactly similar to those in the septic

tank, and, although, a certain amount of decomposition may take place with a production of carbon dioxide just as in the septic tank, the process which takes place cannot be one of nitrification, owing to the fact, that, the oxygen which is necessary to nitrification is displaced from the filter bed by the sewage. Nitrates, and nitrites, the products of nitrification, are, however, found in the effluents. The only other conclusion possible is, that, nitrification takes place, no during the period of contact, but, during the period of rest and that with reference to sewage purification this is the most important period in the contact bed cycle. In Chapter II., dealing with the rôle of bacteria and oxygen we fully dealt with the process of absorption and oxidation as now understood. The purification effected by a contact bed is now explained as a process of absorption during the period of contact by a material filter, and further oxidation of the absorbed matters retained after the liquid is drawn off. This point is one of great significance, leading up as it does to the modern and improved form of process known as the percolating biological filter.

The Fifth Report of the Royal Commission on Sewage Disposal states, page 51, par. 99: "Our knowledge of the action of a contact bed is very incomplete, and little is known as to the manner in which the organic substances of sewage are broken down during the first stages of fermentation into carbon dioxide, ammonia, etc. The purifying agents seem to be not only bacteria, but also worms, larvae, insects, etc., and we can offer no opinion as to the respective amount of work done by each set of agents. It probably differs to some extent according to the nature of the sewage. It has been observed that at some places large numbers of worms are present, while at others, there are comparatively few. Little is known of the kind of bacteria essential for purification, or as to their mode of action, and we are not able to state whether they act chiefly during the period of contact or during the period of rest, or aeration, after the filter is emptied. Ther are grounds, however, for thinking that the resting period is the more important phase of the cycle."

"The generally accepted theory as regards nitrogenous matter seems to be that the ammonia is extracted from the liquid during the period of contact and oxidized during the period of rest, and that the resulting nitrate and nitrite are diffused through the liquid of a subsequent filling. All the ammoniacal nitrogen, however, does not appear in the effluent in the oxidized state, for there is always loss of nitrogen, as nitrogen gas during the process.

"The withdrawal of suspended and colloidal matter from the sewage during its passage through the bed appears not to be a simple mechanical effect of the material, for a matured contact bed, not clogged, will withdraw more suspended matter from the sewage than another bed similar in all other respects, but not matured."

Although it appears, that, the Royal Commission do not commit themselves to any definite theory of the purification process of contact beds, it is apparent, that, they do not give much weight to the contact period relative to the process of purification.

Professor Dibden's experiments and conclusions, published since the Commissioners report, leave little doubt that Dibden's theory on which he based the contact bed has no scientific basis.

(To be Continued.)

**Erratum.**—Owing to Mr. Murray being out of Toronto last week, he had no chance of going over the proofs of the last article. Attention is called to the word "now" which occurs frequently, and which is printed as "more." It will be noted that this has the effect of entirely transposing the intended meaning of several sentences.

(Ed. San Rev.)

## AIDS TO NAVIGATION NEAR BELLE ISLE.*

P. E. Parent, B.A. Sc., M. Can. Soc.†

I believe there are very few of you gentlemen who have, in your travels, visited a gulf, river or lake, with the special object of studying the aids to navigation established for the benefit of mariners in particular, and the country in general.

In this paper, I shall confine myself to the works in that part of the Quebec District which begin at Portneuf, above Quebec, and terminate at Belle Isle, comprising the whole of the north coast, Anticosti Island, the Strait of Belle Isle, the western coast of Newfoundland, the group of Magdalen Islands, the North Shore of Baie de Chaleur, Gaspé Basin, Gaspé Coast, South Shore of the St. Lawrence up to Platon, Saguenay River and Lake St. John. I also wish to state that I could not possibly, this evening, enter into any technical details of construction, our time being limited. This paper will treat of general outlines and is to be considered more as a narration than a professional study.

The aids to navigation in the Quebec District, as elsewhere, consist mainly of buoys, lighthouses, fog alarms, submarine bells and wireless telegraph stations.

**Buoys** are generally placed in shallow water to indicate channels, entrances to harbours or isolated shoals. Spar buoys are made of long cedar posts so shaped as to allow of their receiving a certain number of weights at their lower ends, which cause them to float perpendicularly in the water when anchored. These buoys are used in minor channels or are put in place of gas buoys in the fall when these costly buoys might be damaged by ice.

Wooden buoys of a conical shape, made on the principle of a tub, with staves and hoops, are very little in use now, having been supplanted by steel buoys.

Steel buoys are made cylindrical or conical in shape, as they are designed for use on the port or starboard side of a channel, and of all sizes, according to the requierments. The most important buoys now used are gas buoys. They are made of steel, are huge in size and of special designs. In the body of these buoys a large quantity of gas is compressed if Pintsch gas is used, or they are loaded with carbide if an acetylene light is to be shown. On the top of these buoys the illuminating apparatus is installed with its complicated and delicate machinery, allowing only a limited quantity of gas, at a regulated pressure, to reach the burners at a time, and showing an occulting light when necessary. These buoys are placed to mark each side of the main channel at spots known as dangerous for ships.

The gas buoys have to be inspected quite frequently, as the slightest defect in the mechanism of the illuminating apparatus or leakage of gas may cause the extinguishing of the light, and thereby become a source of accidents. Few gas buoys have been known to work perfectly during six months without requiring a new supply of gas or carbide.

There are also enormous bell and whistling buoys that are used to mark shoals far out from land, and in localities too far away to be frequently inspected. These buoys are of steel and carry a bell or a large whistle which is operated by the swells of the sea.

**Lighthouses.** There is a large variety of lighthouses, but all have the same object in view: guiding the mariner through channels, harbor entrances, or as sentries indicating to him the presence of a known coast, cape, island, etc., from which the course of a vessel can be verified or a new one shaped. The general term "lighthouse" means a tower over which a lantern and illuminating apparatus are erected, the power of the illuminating apparatus alone being taken into consideration in the classification.

*Paper read before the members of the Quebec Branch of the Canadian Society of Civil Engineers, on the 19th February, 1909.

†Engineer of the Department of Marine and Fisheries for the District of Quebec.

The least important lights, as to their construction, consist of poles, at the upper extremity of which mast-anchor petroleum lamps are hoisted every night, the dioptric lenses of the lantern showing a white or red fixed light that can be seen at distances varying from five to ten miles. These poles are placed at the outer ends of wharves or on land, and sometimes in range to indicate the entrances to minor ports through rocks, boulders and shoals.

Then come lighthouse towers built either of wood, cast iron, steel, brick, stone or reinforced concrete. These towers vary in size and height, according to the elevation of the ground and the distance from which the light is to be seen at sea.

The wooden towers are either square, hexagonal or octagonal in shape, with sloping sides. The stout framing is sheathed with tongued and grooved lumber, generally covered with shingles.

The cast iron ones are circular in plan, carrying their full diameter to the top. They are built of sections bolted together and the joints made in putty.

The steel towers consist of skeletons made of angle iron with diagonal rod bracing.

towers, lanterns are built to receive the lenses, which vary in size, power and description. These lanterns are made of wood with glass panels for fixed lights of minor importance, and of cast iron or steel and copper with huge glazings when apparatus of the first, second, third or fourth order are to be placed therein. The largest lanterns measure fourteen feet in diameter by thirty-five feet in height from floor to top of roof.

The illuminating apparatus is classified into seven different grades or orders, according to their illuminating power. The following figures are only approximate and depend upon the climatic conditions, as well as upon the height of the light above the water.

| Order. | Distance Seen. | Candle Power. |
|---|---|---|
| Hyper-radial. | 70 nautical miles. | Special. |
| 1 | 50 " " | 3,000 |
| 2 | 40 " " | 1,500 |
| 3 | 30 " " | 1,200 |
| 4 | 20 " " | 700 |
| 5 | 15 " " | 300 |
| 6 | 10 " " | 200 |
| 7 | 6 " " | 100 |

**Cast Iron Light, Cape Bauld.**

Many stone and brick towers were built by the British Government under the supervision of the Trinity House, before Confederation. They have proved to be everlasting structures, requiring but a few minor repairs to keep them in good order. These towers have the shape of a frustum of a cone with bases twenty feet to thirty-five feet in diameter. The masonry walls at the level of the ground measure from five to seven feet in thickness, according to the height, and at the level of the lantern floor are about two feet thick. Within the past few years the Government of Canada has constructed, amongst others, a few reinforced concrete towers, and up to now this mode of building has given entire satisfaction. These are cylindrical in shape and measure about ten feet in diameter with walls six to eight inches thick, varying with their height. The towers, measuring from sixty to seventy-five feet high, have been strengthened by buttresses, which improve their appearance a great deal.

In a general way, all the lighthouses are designed not only strong enough to carry the lanterns and illuminating apparatus, which sometimes weigh close on to fifteen tons, but also to stand the pressure of the winds without any vibration whatever. This is absolutely necessary for the good and steady working of the light. On the top of these

The lights are either fixed or revolving. When revolving they give flashes of short duration and eclipses of a known number of seconds. Each light has its own characteristic which makes it easy to be distinguished from others. For instance, Greenly Island shows a flash every two seconds, while Cape Norman gives a group of three flashes every thirty seconds (flashes at intervals of six seconds followed by an eclipse of seventeen seconds).

The illuminating apparatus of a revolving light generally consists of a solid cast iron pedestal carrying a basin containing mercury, a burner and mantle. The basin receives a cast iron base floating in the mercury, and this carries the dioptric lenses, which is made to revolve by huge clockwork operated by a heavy weight descending to the ground through a shaft. The basin and float are so designed as to require a comparatively small quantity of mercury (about 600 lbs.) to carry the aggregate weight of the casting and the lenses, which is 7,000 pounds for a first order installation.

In some illuminating apparatus the lenses are fixed, and a thin sheet iron diaphragm fitted to the float travels between the burners and the lenses, causing the flashes and eclipses. Such lights are called occulting.

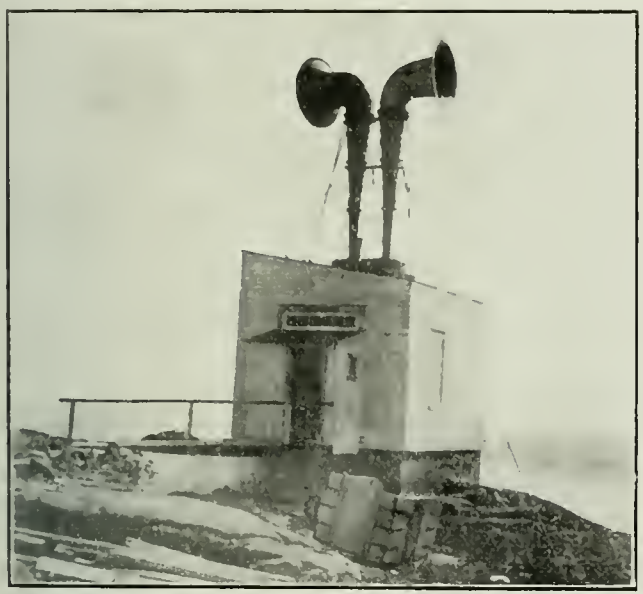
When the light is fixed, the apparatus is greatly simplified, the clockwork, basin and float being dispensed with.

The lighthouses have to be operated from early spring to late fall, and render incalculable service to navigation during clear weather, but during fog they become about useless. To obviate this, many sound signals have been tried with more or less success.

**Guns, Etc.** At some stations guns are fired or gun cotton cartridges exploded. When the sound is heard by a ship it indicates land at short range. These are no longer used at our principal stations. After this came the steam whistle, which gave satisfaction until a more modern fog alarm was found on the market.

**Fog Alarms.** The latest installations consist of machines operated by steam, oil engines or water power compressing air to a working pressure of 30 pounds in large steel tanks, from which it is conveyed to a diaphone. When the diaphones are in operation a piston of special description vibrates inside, producing a deep sound, which is amplified by a large cast iron horn or resonator placed outside of the building.

The small plants, such as established at Bicquette, Ste. Félicité, Seven Islands, Bird Rocks, etc., produce sounds that are heard three to ten miles from the station. As to the large plants, such as those of Martin River, Cape Mag-



**Siren House and Resonators, Belle Isle, S. W.**

dalen, Fame Point, Cape Rosier, Cape Ray, Cape Anguille, Greenly Island, Point Amour, Cape Norman, Cape Bauld, Belle Isle, South-West, and Belle Isle, North-East, they emit sounds heard ten to twenty miles away, according to the atmospheric conditions of the weather and the direction of the wind.

Now, gentlemen, I have given you a general description of the lighthouses and fog alarms established in the Quebec District. I would consider the object I have in view far from being satisfactory if I did not describe more thoroughly a certain number of lighthouse stations.

A small ravine, decked with timber and deals, about fifteen feet above the sea, serves as a landing place at South-West Belle Isle, and has to be reached by climbing over uneven rocky steps and narrow wooden stairs secured by ring bolts. These wooden works are sometimes carried away two or three times during the same summer season by heavy seas, and are to be replaced by permanent concrete works in the near future.

From the landing wharf the road takes us to a shed where the supplies are sheltered as soon as landed, then to a building called the power house. This is where you find the air compressors, which are driven either by the water wheel or the oil engine, each fifteen H. P. strong. The Pelton water wheel is fed by a 12" cast iron pipe, having its inlet at the discharge of a small lake on the top of the hill behind the building. The lake was dammed so as to store as much water as possible, and its level is 176 feet above the water wheel. The cast iron pipe also supplies water to cool the compressors when in operation, this being done by water circulation in a jacket around the cylinder.

The oil engine is kept as a standby in case the hydraulic plant becomes defective. Duplicate plants will be found at every fog alarm station, this being an absolute necessity to ensure an uninterrupted service.

Large tanks full of compressed air are here, but not the sirens and resonators; these are over a mile away, south. A four-inch pipe conveys the compressed air to the horn house and is laid on the ground on the border of the road.

The horn house is a building about ten feet square, in which is installed a first-order double siren, operated by compressed air, and the sounds are amplified by the two enormous funnels or resonators you see above the roof. The emission of the sounds is governed by a timing device which causes the sirens to give blasts of high and low notes alternately, thus: Low note 2½ seconds; silence 2½ seconds; high note 2½ seconds; silent interval 112½ seconds, making two blasts every two minutes. During this period, 400 cubic feet of air are used, each blast requiring 200 cubic feet. The compressor in the power house maintains the pressure in the air tanks, as it compresses one cubic foot of air per stroke, and has a speed of 200 revolutions per minute.

The individual characteristic of each fog alarm being known to all the mariners, it becomes very easy for them to locate their position as soon as they hear the sounds, and to steer their vessels accordingly.

The sirens and horns were located here so as to face the track followed by the steamers, whereas this would not be so if the plant were concentrated at the power house. On the other hand, the power house was located where it is so as to benefit by the hydraulic power and be within easy reach of the landing, the transportation of fuel, such as coal or petroleum up and down steep hills being most difficult and expensive.

The lighthouse is located on the top of the southern head, 467 feet above the sea. The tower is built of solid masonry, as well as the keeper's dwelling, which nestles alongside of it. The house is large, well lighted, thoroughly clean, in fact cosy enough to indicate the presence of an industrious wife. (Most of our lighthouse keepers are married and live at their stations with their families). From the house we reach the interior of the tower through a short covered passage, and begin to ascend the long winding stairs, which take us to the lantern floor, sixty feet above the ground. We are in a first-order French revolving light. Another short flight of stairs will take us to the level of the lenses, burner, etc., in fact in the very heart of the lighthouse. The lantern will permit the whole party to stand inside if not numbering more than twenty. Petroleum vapour is burned under a mantle and produces a blinding light of 3,000 candle power.

At night it is really dazzling to be here and watch this illuminating apparatus slowly revolve around its axis in a silence, disturbed only by the hum of the fan regulating the speed of the clockwork and the buzzing of the gas burning in the mantle. It is also most impressive to stand on the outer balcony when the air is calm, or during storms, and watch the enormous rays of light scrutinizing the horizon through the darkness, and seeming to search for lonely vessels to bid them a happy voyage or welcome their return to our waters.

Fog is very capricious; it will sometimes rest heavily on the surface of the ocean, leaving the tops of hills entirely clear; at other times float in the air in large clouds, hiding tops of mountains and lighthouses highly situated. Owing to its isolated position in the midst of the ocean Belle Isle is particularly subject to the latter phenomenon. To remedy this to a certain extent a second light was installed on a concrete foundation, 350 feet below the light we have just visited, and on the very brow of the cliff, 117 feet above the sea level. Under ordinary circumstances one of the lights can be seen, when not both.

Here are the storehouses, sheds and stables, for the keeper's use, and a little farther, this long, low building that you see, is used as the quarters of the Marconi wireless telegraph operators. These operators spend all the summer season at the station and are removed in the fall as soon as navigation closes. Their work consists of signalling and reporting vessels, transmitting messages, etc.

Besides these operators, the lighthouse keeper and his family, there is not a single human being at this end of the Island. Twelve miles north-east, at the other end of the Island, you will find another lighthouse station and a keeper living under the same conditions.

**Fame Point. Old and New Light.**

There are over 350 small lakes on this island, but you would see practically no vegetation. The rocky surface is covered with thick moss with occasional patches of poor soil where short brush grows. This is dne, I suppose, to the shortness of the summer season and the severity of the winters. Besides this, during storms, the wind blows with such velocity and force that trees of any size would be uprooted and carried away.

Please notice that not a grain of sand is to be found; this, together with the absence of other construction materials, will explain to you the reasons why it is so costly to carry out construction work at stations such as these. Everything has to be brought here by steamers, unloaded with surf boats, hoisted on the landing platform with derricks and hauled to the place where required, over a rough road, up and down hills.

Tradesmen and laborers, with food and complete camping outfit, horses or oxen with feed, trucks, carts, etc., have also to be brought from elsewhere, and this for a space of about four months only, July to November, work being impossible before or after these months.

Cape Bauld is the most north-easterly point of Newfoundland, practically as much outside of communication with the rest of the world as Belle Isle. On the top of the Cape you see the lighthouse, the fog alarm building, the keeper's dwelling and dependencies, which, at a distance, show as so many white spots on a dark grey background. The lighthouse, 60 feet high, built of cast iron sections, carries a third-order revolving apparatus that dominates the surrounding peaks and boldly throws its flashes on the ocean. The fog alarm, more modest in appearance, seems to await its turn to prove its usefulness. Built on the crest of the Cape, it is always ready at a moment's notice to cry out to the ships to keep away from the rocks. The plant of this alarm, being exactly the same as those of Cape Norman, Point Amour and Greenly Island, will be described later.

At Cape Norman where the lighthouse and other buildings resemble those of Cape Bauld, the great problem is to find means of gathering a sufficient quantity of fresh water to feed the boilers of the alarm plant. This is true of many othe stations.

In the rocky formation of these Capes, natural springs are very seldom found, and the only way of getting water is to store surface water in depressions of land by building concrete dams, thereby obstructing its escape. It is also found advantageous to conduct by spouts into a large cistern under the boiler-room, the water coming from the roof of the fog alarm building.

Point Amour or Forteau is 60 nautical miles from Belle Isle. The station is built on comparatively low land with a range of sloping hills to the north-west. There you will see a tower of the same style as that of Belle Isle. The Marconi telegraph office of this station is continually in direct communication with Belle Isle and Point Rich, reporting passing vessels and transmitting messages.

Greenly Island, small in size, is situated on the north side of the strait, only three cables to the west of the boundary line dividing the Canadian Labrador from Newfoundland territory. It is one of the most important fishing stations of the Gulf, cod being generally plentiful during the summer season. Newfoundland fishermen arrive in the spring and return home in the fall with the produce of their labors. This island is low and of a very peculiar shape. This island has a small bay that has a bright appearance with its long sandy beach and dozens of small white wooden houses built close to the shore. It is from here that most of the sand is loaded on the supply steamer and transported to Belle Isle, Cape Bauld, Cape Norman, Bird Rocks, etc., for concrete and masonry work. As we follow the road, we notice on the left hand side that the ground is swampy in a certain place particularly. This was taken advantage of to establish a supply of fresh water. The lowest portion of the swamp was well cleaned by removing about two feet of thick grass and sandy soil to the surface of the rock, and building a low concrete dam about 100 feet long, to prevent the free escape of water. A small lake is thus formed and fed by rain and water produced by fog that filtrates through the soil and slowly descend towards the artificial pond. A 2" galvanized iron pipe with its inlet in the dam conducts the water for a distance of about 700 feet to a large cistern built in solid rock next to the fog alarm building. From there it is pumped into the

**Upper Light, Belle Isle, S. W.**

boilers and the jackets around the air cylinders for cooling purposes. The fog alarm building is made of wood, measures 30 feet broad by 60 feet long, with sloping roof. It is well anchored to a solid concrete foundation, and the floors inside are also made of concrete. The three 25 H. P. Robb-Mumford boilers occupy half the bulding, are heated with coal and carry a working pressure of 80 pounds. The steam piping is so arranged as to permit any of the boilers to be used alone if necessary. The seaward half of the building contains two large double-action compressors with steam and air cylinders measuring 10" diameter and 12" stroke. These machines run at a speed of about 80 revolutons per minute,

each compressing 150 cubic feet of air to 30 pounds pressure during that period. The timing device is operated by a strap running on a small pulley fitted to the shaft of the fly wheels and regulates the admission of compressed air to the diaphone by means of a small wheel with cams, raising a lever that opens a valve, and this exactly in accordance with the characteristic of this plant, which calls for a blast of five seconds every minute. The horn or resonator is placed outside of the building at the gable end. It is made of cast iron ½" thick, measures four feet long, 15" at its opening and 4" at the end connected to the air pipe from the diaphone.

It must not be forgotten that generally only one boiler and one compressor are operated at a time, the others being standbys, in case something goes wrong with the parts in use.

The engineer in charge of this plant is well equipped with tools to enable him to keep the machinery in good order and execute minor repairs. He always has spare pieces on hand, such as pistons, diaphones, valves, wrought iron pipes, etc. The fuel used in the boilers is stored in a large coal shed near the landing as soon as landed, and thence carted, as wanted, to a smaller coal shed adjoining the boiler room.

At this station, the lighthouse and keeper's dwelling form but one building, with a tower rising from one of the corners. It is built of wood sheathed with shingles painted white, and stands on the highest level of this end of the island. The tower is octagonal in shape and carries a second-order dioptric illuminating apparatus, flashing every two seconds.

Greenly is not so isolated in the summer as the stations described previously, Newfoundland coasting steamers calling here about twice a month at fixed dates, and the presence of a large number of fishermen with their families and fishing outfits being a source of comfort and benefit to the keeper.

Cape Anguille station, which is 15 miles north of Cape Ray, is located about 20 feet above the sea on a large plateau bounded in the rear by a high range of mountains advancing towards the sea in the north. It was established only a few years ago to command that part of the gulf between Cape Ray and Cape George. The keeper's dwelling and fog alarm building are built of wood and resemble constructions already visited, more particularly the fog alarm which is almost a duplicate of that of Greenly Island. The remarkable feature here is the lighthouse tower, built of reinforced concrete and measuring ten feet in diameter, 90 feet in height, with walls 8" thick. It is built on a solid mass of concrete resting on shale three feet below the level of the ground. This immense column is steadied by six large flying buttresses, 1' x 4' at the base, diminishing in size as they rise up, until they measure one foot square under the flooring of the balcony. Please note that the buttresses do not form a solid body with the tower, but are only connected to it in three places. In the construction of these works, expanded metal was replaced by horizontal and vertical iron rods from ½" to 1" in diameter, well connected and tied together with wire. The winding stairs inside are also made of concrete moulded as the work progressed. The lantern floor was strengthened by two 12" I beam so placed as to carry the weight of the illuminating apparatus, which is of the third order, and weighs about four tons.

The concrete was made with the following ingredients: International cement, one measure; clean and crisp sand, two measures; four measures of broken stone with a small proportion of gravel, and sufficient fresh water to obtain a thick mortar. When the moulds were removed, the concrete surface was brushed with two coats of thin cement mortar to give it a smooth appearance.

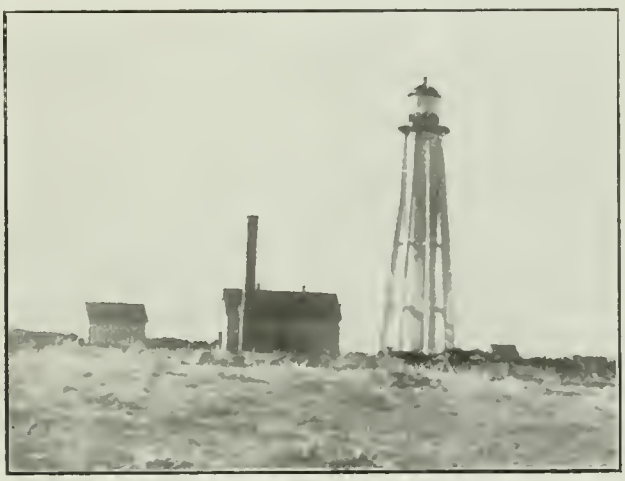
As I have said before, these towers look very well and are absolutely steady, showing no signs of vibration during winter storms, otherwise the mantles would be quickly destroyed and the mercury in the basin scattered in the lantern.

I am sure you are anxious to learn why the Government of Canada is expending money in establishing costly stations on strange land. It would seem that this should be done by our friends, the Newfoundlanders, who already possess and maintain a large number of harbour and coasting lights.

In my opinion, the present arrangement is the most equitable, Newfoundland being more interested in its coasting trade than in ocean navigation. If you glance at a chart of the gulf, you will see that the Canadian lighthouses are built mainly for the benefit of Transatlantic trade, to serve as guides to vessels sailing for or from Canadian ports.

Those who see the Bird Rocks for the first time are quite astonished to find such a small island practically lost in the middle of the gulf. Owing to its peculiar aspect I believe it will be interesting to give here a condensed extract of a report made in 1903 by Mr. J. Obalski, Mining Engineer of the Department of Lands, Mines and Fisheries, Quebec, on the geological formation of this group:

"Bird Rocks, together with the two very small peaks a quarter of a mile to the north-west, forms part of the group of the Magdalen Islands. This group consists of 13 islands of different sizes, and must have formed part of the continent at some period of their geological history, and must have been connected with Prince Edward Island, situated 50 miles to the southward. The geological formation of these islands thus presents great uniformity, and what may be said of one applies to the others. It consists of beds of



**Cape Anguille Light and Fog Alarm.**

grey or reddish sandstone, generally broken up and resting on the eruptive rock, which has been called diabase and dolerite, but which presents a variety of basic rocks probably of rather recent origin. The aspect of these rocks is, moreover, variable according to their more or less advanced state of decomposition. It is quite possible also that there have been several periods of eruption, or rather that an ancient eruption has been brought to light by a more recent one, which would explain the fact that compact diorite is found in the vicinity of the diabase or even the trap which, on contact with the atmospheric elements, disintegrates and decomposes, forming banks of clay of various colors. The sedimentary formation of these islands, as well as that of Prince Edward Island, had been classified by the Geological Survey in the lower carboniferous, characterized by limestones containing fossils and surmounted by the sandstone above mentioned."

This rock is about 8800 feet long and about 400 feet wide, with its shore cliff 120 feet high and almost perpendicular. All around you see natural cornices and small grottoes, inhabited by myriads of white sea birds.

When construction work began on this rock it was no small undertaking to send men to the top to haul up the materials for the erection of a derrick, which was used for many years in hoisting men and materials in connection with the building and maintenance of the station. Later, some blasting was done for the installation of an inclined railway, over which a small car is made to travel by a steam winch. At the foot of this railway a small cribwork wharf has been built to receive the materials and supplies

brought in surf boats from the steamer. Alongside of this railway line are stairs that you may climb up if you are not affected by vertigo.

At the top you see the keeper's dwelling, an ordinary wooden house, requiring no special description. Then comes the lighthouse, built of wood. It was raised some fifteen feet last year, and now rests on a reinforced concrete chamber of hexagonal shape with sides 10 feet wide by 15 feet high.

Close by, on the brow of the cliff, is the fog alarm building, 30 feet square, containing the two 7-H. P. oil engines operating the two air compressors, timing device, diaphone, etc. This plant is not so powerful as those we have already visited, but gives entire satisfaction. It gives one blast of five seconds' duration during every two minutes. As at Greenly Island surface and roof water is gathered for cooling and domestic purposes.

At the east end of Anticosti Island shoal water extends far seaward and is dangerous for vessels during bad weather, when it is not always possible to discern the light. To render navigation safe in these waters a lightship, equipped with a fog alarm and a submarine bell, is anchored eight miles south-east of Heath Point light station during the season of navigation.

This small vessel is manned by a complete crew that has to be on hand day and night. Every night a powerful occulting light is shown from the top of each of its two masts, and the diaphone blows a blast of 4½ seconds' duration every minute when fog prevails.

Besides this, vessels equipped to receive the sounds of submarine bells are further confirmed in their position on the chart when their receiver informs the master that the lightship is not very far off. This device consists of a good sized bell hung in ten fathoms of water and made to ring by a hammer which is pneumatically operated by a special machine installed partly in the bell and partly in the engine-room of the lightship. Like lighthouses and fog alarms, the submarine bells have known characteristics, that is, emit definite numbered sounds divided by silences of certain duration. For instance, this lightship, being known under No. 15, rings once, is silent for 4½ seconds, then rings five times in succession at intervals of one second, and then becomes silent for 10 seconds, thus giving out its number.

All the 175 lights of the district are supplied once, when not twice, a year, with everything necessary, such as oil, fuel, and provisions of all kinds, for the proper working of the station, by the Maintenance Department of the Quebec Agency, and that the Inspector has to visit them yearly to see that the keepers do their duty in every way.

## PRESIDENTIAL ADDRESS BEFORE THE ENGINEERING SECTION OF THE BRITISH ASSOCIATION AT WINNIPEG.*

By Sir W. H. White, K.C.B., Sc.D., LL.D., F.R.S.

On the present occasion, when the meetings of the British Association for the Advancement of Science are held in the heart of this great Dominion, it is natural that the proceedings of the engineering section should be largely concerned with the consideration of great engineering enterprises by means of which the resources of Canada have been and are being developed and the needs of its rapidly increasing population met. It will not be inappropriate, therefore, if the presidential address is mainly devoted to an illustration of the close connection which exists between the work of civil engineers and the foundation as well as the development of British Colonies and Dominions beyond the seas.

* Slightly abbreviated.

British colonies and possessions have started from the sea-front and have gradually pushed inland. Apart from maritime enterprise, therefore, and the possession of shipping, the British Empire could never have been created. An old English toast, once familiar but which has of late years unfortunately fallen into comparative desuetude, wished success to "Ships, Colonies and Commerce." A great truth lies behind the phrase: these three interests are interdependent, and their prosperity means much for both the Mother Country and its offspring. As colonies have been multiplied, their resources developed, and their populations increased, over-sea commerce between them and the Mother Country has been enlarged; greater demands have been made upon shipping and over-sea transport of passengers, produce and manufactures; there has been a growing necessity for free and uninterrupted communication between widely-scattered portions of the Empire, the maintenance of which has depended primarily and still depends on the possession of a supreme war-fleet, under whose protection peaceful operations of the mercantile marine can proceed in safety, unchecked by foreign interference, but ever ready to meet foreign competition.

Now that our colonies have become the homes of new nations it is as true as ever that the maintenance of British supremacy at sea in the mercantile marine and the war-fleet is essential to the continued existence and prosperity of the Empire. The trackless ocean supplies the cheapest and most convenient means of transport and intercommunication; continuous improvements in shipbuilding and marine engineering have abridged distances and given to sea-passages a regularity and certainty formerly unknown. It is a literal fact that in the British Empire the "seas but join the nations they divide." Every triumph of engineering draws closer the links which bind together its several parts. Greater facilities for frequent and rapid interchange of information of what is happening in all sections of the Empire and of knowing each other better should lead, and has led, to increased sympathy and a fuller realization of common interest in all that affects the well-being of the Empire. Within the last few years the events of the Boer War have given remarkable proofs of the practical interest of the colonies in Imperial concerns and their readiness to share its burdens. The present year will always be remembered as that in which generous offers of assistance from the colonies in the task of strengthening the Royal Navy at a critical period have led to a conference whose labors should produce important practical results and make our future secure. Organized co-operation between the Mother Country and the Dominions beyond the seas in the maintenance of an Imperial Navy adequate for the protection of vital interests is essential to that security; and at last, there is a prospect that this end will be attained.

While claiming for the shipbuilder and marine engineer an important place in the creation and maintenance of the Empire, it is recognized that the work of other branches of civil engineering has been equally important. The profession of the civil engineer was described in the Charter granted to the parent institution in 1828 as "the art of directing the Great Sources of Power in Nature for the use and convenience of man; as the means of production and of traffic in states both for internal and external trade, as applied in the constitution of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange; and in the construction of ports, harbours, moles, breakwaters and lighthouses; and in the art of navigation by artificial power for the purposes of commerce; and in the construction and adaptation of machinery and in the drainage of cities and towns." Since this description was penned there have been great and unforeseen developments in many directions, including those relating to improvements in the use of steam, the generation and practical applications of electrical power, the manufacture and extended employment of steel. The main ideas expressed eighty years ago, however, still remain applicable to the beneficient work of the civil engineer. His skill and enter-

prise, backed by adequate financial provision, are continuously being applied to improve and extend means of production, internal and external means of communication, inland and over-sea navigation, the use of mechanical power and appliances, the acceleration and cheapening of transport, the development and utilization of natural resources, and the direction of the sources of power in nature for the use and convenience of man. One of the chief fields of engineering operations at the present time is to be found in the Dominion of Canada, whose governing authorities have appreciated the fact that bold enterprise and generous financial provision for the execution of great engineering works are essential to the progress and prosperity of the country. Its vast extent, its magnificent lakes and rivers, its agricultural and mineral riches, its forests, its unrivalled water power, and many other potential sources of future wealth and progress, furnish exceptional incentives and opportunities to the engineer. From an early period in the history of Canada this fact has been realized, and attempts have been made to utilize natural advantages; while the same policy has been energetically adopted since the Dominion was established forty-two years ago. It is impossible in this address even to enumerate the great engineering works which have been accomplished or are in process of execution; and it might be thought impertinent if the attempt were made by one who has only an outside knowledge of the facts. On the other hand, it may be of interest to illustrate by means of Canadian examples the truth of the general statement that civil engineering has exercised and must continue to exercise great influence upon the well-being and development of the British Empire.

By the kindness of the High Commissioner of Canada, Lord Strathcona—who has himself done so much for the development of the Dominion, including a great part in the construction of the Canadian Pacific Railway—the writer has been favored with official reports and statistics bearing on the subject. These have been freely used in the statement which follows:

The subject is so extensive and the time available for this address so short that it will be necessary to omit detailed reference to important applications of engineering which are necessarily made, under modern conditions, in all great centres of population. Amongst these may be mentioned building construction, sanitation, water supply, heating, lighting, telegraphy, telephony, tramways, electric generating stations and their plant, and gas manufacture. No attempt will be made to deal with the important assistance given by engineers to the operations of agriculture, mining and manufacture, or to the utilization of the splendid forests of the Dominion; although the demands for machinery and mechanical power are in these respects exceptionally great, owing to the sparseness of the population and the magnitude of the work to be done. Notwithstanding the large immigration and rapid increase of population, these demands will certainly continue and will probably become greater as the area under cultivation is increased, as manufactures are developed, and the natural resources of the country more largely utilized. The example of the United States places this anticipation beyond doubt, and demonstrates the great part which the engineer must continue to play in the development of Canada.

Even when the limitations described have been imposed upon the scope of this address the field to be traversed is a wide one; and without further preface an endeavor will be made to describe a few of the most important services which the engineer has already rendered to the Dominion and will render in the immediate future.

### Railways.

It has well been said that the great problem of to-day in Canada is that of providing ample and cheap transport for her agricultural, mineral, and forest products from the interior to the sea, and so to the markets of the world. Important as inland navigation may be as an aid to this enterprise, it cannot possibly compare with railway development in actual and potential results. Apart from that development the one united Dominion must have remained a dream, thanks to the rapid and efficient intercommunication furnished by railways, widely scattered provinces are knit together in friendly and helpful union, literally by "bonds of steel" which stretch from the Atlantic to the Pacific, and reach farther and farther north each year. Regions which would otherwise have remained inaccessible and unproductive have been turned into new provinces, whose fertility and future development it is not easy to forecast, and practically impossible to exaggerate.

In this department successive administrations (both Federal and provincial) have realized the facts and possibilities of the position, and have given substantial assistance to private enterprise in the execution of great engineering works. Progress in railway development has been remarkable since Federation was accomplished forty-two years ago. During the preceding thirty years the total railway mileage in operation had been raised to 2,278 miles; in 1887 it was 12,184 miles; in 1897, 16,550 miles; in 1907, 22,452 miles. The number of miles of railway actually under construction in 1907 was officially estimated at 3,000, exclusive of lines projected but not yet under contract. In 1906, when the lines in operation were 21,353, it was estimated by competent authorities that the railways under construction, and projects for extensions likely to be carried into effect in the immediate future reached a total of at least 10,000 miles, while probable further extensions of about 3,500 miles were under consideration. Further, it was estimated that the capital expenditure required to complete these schemes would be about 60 millions sterling. These figures may need amendment, but there are others representing ascertained facts which equally well illustrate the magnitude of the railway interests of the Dominion.* The total capital invested in Canadian railways in 1907 was officially reported to be about £234,390,000; the aid given to railways up to that date by Dominion and Provincial Governments, and by municipalities, considerably exceeded £36,000,000 sterling in money; the land grants from the Dominion Government approached 32 million acres, while the Provincial Governments of Quebec, British Columbia, New Brunswick, and Nova Scotia had granted about 20½ million acres. The Governments have also guaranteed the bonds of railway companies to the extent of many millions of dollars. The capitalization per mile of railway lines owned by the Governments (amounting to 1,890 miles) is reported as being £11,400; this is practically the same amount as that for Indian railways, that for the United States being £13,600, and for New South Wales and Victoria about £12,600. For British railways the figure given is £54,760 per mile. The freight carried by Canadian railways in 1907 amounted to nearly 63,900,000 tons (of 2,000 lbs.), which included about 14,000,000 tons of coal and coke, nearly 4,500,000 tons of ores and minerals, 10,250,000 tons of lumber and other forest products, nearly 7,900,000 tons of manufactures, and 2,300,000 tons of merchandise. In 1875, when 4,800 miles of railway were in operation, the corresponding freight-tonnage was 5,670,000 tons; so that while the length of railway increased nearly 4.7 times, the tonnage increased nearly 11.3 times. During the same period passengers increased from 5,190,000 to 32,137,000. For twenty-eight railways making returns the average revenue per passenger per mile was 2.232 cents, and for the four principal railways was 2.07 cents. For freight fifty-nine railways showed an average rate of 2.328 cents per ton-mile; and for the five principal railways it was .702 cent per ton-mile. The average distance travelled by a passenger was 64 miles, the corresponding figure for the United States being 30.3 miles. The average distance a ton of freight was hauled was 183 miles, as against 132 miles for the United States. In Canada, as the official reporter remarks, there

* Most of these statistics are taken from the valuable report for 1907, presented to the Minister of Railways and Canals by Mr. Butler, Deputy Minister and Chief Engineer of the Department.

is a small amount of suburban railway traffic and a low density of population. The following table is taken from the official Canadian Railway Statistics for 1907.

| | For each mile of Railway. Population. | Square miles of territory. |
|---|---|---|
| United States | 381 | 13.61 |
| United Kingdom | 1,821 | 5.29 |
| France | 1,590 | 8.46 |
| New South Wales | 686 | 146.09 |
| New Zealand | 358 | 43.42 |
| Victoria | 360 | 25.89 |
| India | 10,119 | 61.09 |
| Canada | 289 | 161.8 |

Canada has therefore the highest mileage measured against population, and the lowest against territory.

The earliest great railway system of Canada, the Grand Trunk, had its beginnings in 1845; in 1907 it was working about 3,600 miles within the Dominion. In association with the Government it is now engaged on the construction of the Grand Trunk Pacific Line, which will cross the continent wholly in Canadian territory, and have a length of 3,600 miles, exclusive of branches.

The story of the Canadian Pacific Railway is well known, and need not be repeated; the influence which its existence and working have had upon the prosperity of the Dominion has been enormous and beneficial since its opening in 1885, and experience of its effect has led to the promotion of other Trans-continental lines. In June, 1907 the total length in operation was nearly 9,000 miles, and the company owned in addition great lines of steamships employed on Atlantic and Pacific services.

The Canadian Northern Railway system represents one of the most striking examples of recent railway development in the Dominion. In 1907 it was working nearly 2,600 miles in the North Western provinces, about 150 miles in Ontario, 500 miles in the Province of Quebec, and 430 miles in Nova Scotia and Cape Breton, making a total of nearly 3,700 miles. In 1908 its mileage on the main system was reported to have increased to nearly 3,400 miles, and the total length in operation had become 4,800 miles. The North Western Provinces have given substantial assistance to this great system, and its promoters are said to aim at a complete Trans-continental route, as well as the development of railway communication to Hudson's Bay and the establishment of a line of steamships therefrom to Great Britain.

Besides these three great railway organizations, which in 1907 controlled about 75 per cent. of the mileage in operation, there are a large number of smaller companies, making up a total of about 80. Their total earnings in 1907 amounted to £29,350,000, the total working expenses being £20,750,000. Earnings from freight service were (in round figures) £19,000,000; from passenger service £7,837,000; from express services £655,000; from mails £325,000, the balance coming from miscellaneous items. The total number of persons employed by the railways was 124,000; their salaries and wages amounting to £11,750,000. It was officially estimated that if to the railway employees were added persons employed in factories for rolling stock and railway materials, as well as those engaged in the casual service and shipping, with an allowance for their families, 'quite 25 per cent. of the population win their daily bread from the carrying trade' of the Dominion.

The equipment of the Canadian railways in 1907 included 3,504 locomotives, 3,642 passenger cars, and 113,514 freight cars. In the opinion of the official reporter on railway statistics, based chiefly on a comparison of the proportion of rolling stock to mileage in Canada and the United States, a considerable increase of rolling stock is required, and there is a possibility of greater efficiency being obtained in the utilization of existing freight cars. The manufacturing resources of the Dominion are declared to be fully capable of meeting all requirements, as in 1907 they produced 227 locomotives, 397 passenger cars, and 13,350 freight cars. A reduction of grades and curvatures has been carried out on the principal railways in recent years, and this has permitted the hauling of heavier loads. It is estimated that in 1907 the average earnings per ton of freight hauled were $1,472, and the average earnings per passenger carried were $1,219. The earnings per train mile were $1,953, and the working expenses $1,381. The total earnings per mile of railway were $6,535.64, and the working expenses were $4,620.9. The working expenses were divided as follows in the official report:

Maintenance of way and structures..20.13 per cent:
" equipment.....20.88 "
Conducting transportation .....55.25 "
General expenses ..... 3.74 "

Allowing two cords of wood fuel to be equal to one ton, 5,609,000 tons of fuel—of which 5,578,000 tons were coal—were consumed by Canadian railway locomotives in 1907 in running 100,155,000 miles. The total cost was about £3,027,500, equal to 14.59 per cent. of the working expenses.

From this brief summary of facts some idea may be gained of the rapid development of Canadian railways, their immense capital value and traffic, and the remarkable influence they have had upon the progress and population of the Dominion. It is a matter for satisfaction that British capital and engineering skill have contributed in no small measure to produce this development, and it may be hoped that in the future they may render even greater service.

### Inland Navigation.

The most important system of inland navigation which Canada possesses is primarily due to the existence of the Great Lakes and the St. Lawrence River; but the utilization of these natural advantages and the construction of a continuous navigable channel from the sea to the head of Lake Superior is due to the work of engineers. The importance of such a navigable waterway leading to the heart of the Dominion was recognized long ago by the Government. The first canal is said to have been opened in 1821, and from that time onwards the canal system has been developed, but the greatest progress has been made during the last forty years under successive administrations. Up to March 31, 1907, the capital expenditure on Canadian canals, exclusive of outlay by the Imperial Government, has approached £18,350,000 sterling, of which more than ten millions have been spent on enlargements. Besides minor canal systems, many of which are important, a great '.trunk system' of water-transit has been created from Montreal to Port Arthur, at the head of Lake Superior, this all-water route being nearly 1,300 miles in length, having a minimum depth of 14 feet and effecting a total vertical rise of about 600 feet from tidal water in the St. Lawrence to Lake Superior. In order to effect this rise forty-nine locks are provided, most of which are 270 feet long and 45 feet wide, enabling vessels 255 feet long to be accommodated. Out of the total length of more than 1,200 miles only 73½ miles consist of artificial channels. The Welland Canal, connecting Lakes Erie and Ontario—with a total rise from lake to lake of 327 feet, effected in twenty-five locks—is 26¾ miles long. This canal dates from 1824; its enlargement to present dimensions was begun in 1872, and occupied fifteen years; the total expenditure on the canal has been nearly five and a-half millions sterling. Another important section of the waterway is the Sault Ste. Marie Canal—about 6,000 feet in length and from 142 to 150 feet wide between the pier-ends, with a lock 900 feet long, 60 feet wide, having 20¼ feet of water over the sills. The difference of level between Lakes Superior and Huron is 18 feet. Commenced in 1888, the Sault Ste. Marie Canal was opened for traffic in 1895, the cost being about £930,000. Like its predecessor on the United States' side of St. Mary's River—the so-called 'Sno' Canal affords free passage for the ships of both countries. In 1908 about two and three-quarter millions represented the tonnage of vessels passing through the Canadian Canal, and of this total about 403,000 tons was in Canadian vessels. In 1907 the total tonnage had risen to 12,176,000 tons, of which 2,288,000 was in Canadian vessels. The Soulanges Canal is fourteen miles long, with a rise of 84 feet effected in four locks. Commenced in 1892, it was

opened for traffic in 1899, and cost nearly £1,400,000. The Lachine Canal was commenced in 1821, enlarged in 1843 and 1873, and, as completed in 1901, is 8½ miles long, has 45 feet rise, effected in five locks, and has cost from first to last about £2,300,000.

In the construction of this great waterway many difficult engineering problems have been solved, and every modern improvement has been introduced; electricity has been utilized in its equipment, both for power and lighting, so that navigation can proceed by night as well as by day. For the years 1903-7 the canals were declared free of tolls; but it is estimated officially that if tolls on the ordinary scale had been collected the revenue for 1907 would have exceeded £91,000. In these five years the water-borne traffic of the Dominion increased from 9,204,000 tons in 1903 to 20,544,000 tons in 1907; in the same period the increase in Canadian railway traffic was from 47,373,000 tons to 63,866,000 tons. The official reporter justly remarks that 'these results are exceedingly encouraging.'

It was recognized long ago that the utilization of the waterways of Canada from the Great Lakes to the sea would yield considerable advantages by facilitating cheap transport of agricultural products of the fertile regions from the great North West, but the Canadian portions of that territory were then regarded as 'a great lone land.' Subsequent developments of the corn-growing regions of Canada have emphasized the value of the water route and its great potentialities. In his 'History of Merchant Shipping' (published 1876) Lindsay dwelt upon this point, and foresaw that if the waterways of Canada were made continuously navigable a struggle for supremacy in over-sea trade must arise between New York and the Canadian ports of Montreal and Quebec. This struggle is now in full force, so far as the grain trade is concerned, and it is likely to grow keener. The quantity of grain passed down the whole length of the St. Lawrence navigation to Montreal increased from about 450,000 tons in 1906 to 685,000 tons in 1907, while the quantity carried to Montreal by the Canadian Pacific Railway was about 387,000 tons for 1906 and 384,000 tons for 1907. On the other hand, the quantity carried by canals in the United States to New Pork fell from 294,500 tons in 1906 to 230,800 tons in 1907.

An important addition to the Canadian canal system has been proposed, and its execution will probably be undertaken when great works now in progress have been completed. This route extends from Georgian Bay on Lake Huron to the St. Lawrence, and would utilize Lake Nipissing as well as the French and Ottawa Rivers. The distance to be traversed would be 450 miles, less than that of the present all-water route. On the basis of careful surveys it has been estimated that a canal having 20 feet depth of water could be constructed at a cost of twelve millions sterling, upon which capital a reasonable dividend could be paid, even if the charges made for transport were one-third less than the lowest rates of freight possible on United States routes to New York. It would, of course, be most advantageous to have the available depth of water increased from 14 to 20 feet, thus making possible the employment of larger and deeper draught vessels between the lakes and Montreal. Considerable economies in the ratio of working expenses to freight earnings would be effected, break of bulk in transit to the sea would be avoided, and the cost of transport greatly reduced.

The magnitude of the grain trade and its growth may be illustrated by the following figures for recent years:—In 1897 the grain cargoes passed down the Welland Canal to the ports of Kingston and Prescott numbered 377 and represented 515,000 tons; for 1907 the corresponding figures were 518 cargoes, weighing 841,000 tons. As to the elevators and mechanical appliances for handling economically these huge quantities of grain, nothing can be said here, although they involve the solution of many difficult engineering problems and have greatly simplified and improved as experience has been gained.

The bulk of the canal traffic, of course, moves eastwards and outwards from the interior provinces. For example, of the total quantity of freight (11,631,21[illegible] tons) passed through the whole length of the Welland Canal in 1907 about 75 per cent. moved eastwards, and more than 62 per cent of the 2,100,000 tons which passed through the St. Lawrence canals moved in the same direction.

### Water Power.

Canada has unrivalled resources in water power, and its extent and possible utilization have been made the subject of investigation by engineers for many years past. One of the most important memoirs on the subject was presented to the Royal Society of Canada in his presidential address of 1899 by Mr. Keefer, C.M.G. In recent times many other engineers have studied the subject and carried out important works. Exact knowledge of the total power represented by the water falls and rapids of the Dominion is not available, nor can any close estimate be made of the power which may be employed hereafter in factories, mills, or industrial processes, because profitable employment obviously depends upon commercial considerations, which must be governed largely by the localities in which water power may be found, and the cost of works and of transmission of energy to places where it can be utilized. It has been estimated that on the line from Lake Superior through the chain of lakes and rivers leading to Niagara and thence through the St. Lawrence to the sea eleven millions horse power may be developed.* Mr. Langelier has estimated that in the Province of Quebec the water power aggregates more than eighteen millions horse power; other provinces all possess large resources of the same kind as yet untouched. The most striking example of the utilisation of water power is that on the Niagara River, which the writer had the good fortune to visit in 1904, during his presidency of the institution of Civil Engineers; the works on the Canadian side were then in full progress, and at a stage which enabled one to realize completely their great difficulty and immense scale. The three companies whose works are near the Falls on the Canadian side have provided for a total ultimate development of over 400,000 horse power, and a fourth establishment lower down the river, intended chiefly for the use of Hamilton, is to develop 40,000 horse power. In the construction of the works, in the electric generating plant, the arrangements for transmitting power over long distances, and other features of importance remarkable engineering skill and daring have been displayed. American capital and enterprise have much to do with these undertakings, as they have with many other important Canadian enterprises; but it may be hoped that British capital will keep its lead and be freely employed in the development and utilisation of all the resources of the Dominion, including that magnificent asset its water power. The applications of water power are already very numerous, including not merely the creation of electrical energy and its use for lighting and power in towns and factories situated at considerable distances from the Falls, but for manufactures and industrial processes carried on near the Falls. Amongst these manufactures, that of aluminium and carbide of calcium may be mentioned, while paper and pulp mills and saw mills constitute important industries. Great advances have been made in the transmission of electrical power over long distances, and very high pressures are being used. Electric traction on railways and tramways also derives its power from the same sources, and is being rapidly developed. In 1901 there were 553 miles of electric railways, and in 1907 815 miles.

### Over-sea Trade and Transport.

It was remarked at the outset that a great truth is embodied in the old toast of 'Ships, Colonies and Commerce,' and the efficient and economical transport of passengers, produce, and manufactured goods between the Dominions beyond the seas and the Mother Country is essential both for the development of colonial resources and for the continued prosperity of the United Kingdom. The British mer-

* The Times Financial Supplement, April 2, 1906, contains a valuable article on this subject, from which many of the above figures are taken.

cantile marine commands the larger portion of the carrying trade of the world; its earnings constitute a valuable item in the national income; it forms one of the strongest bonds of union between the various parts of the Empire. This general statement may be illustrated by reference to the over-sea trade of Canada and to the shipping engaged therein.

The total value of the imports and exports of the Dominion in 1898 was close upon 61 millions sterling; in 1908 it exceeded 130 millions sterling, having more than doubled within ten years. During the year ending March 31, 1908, the vessels which were entered at Canadian ports (inwards from the sea) carrying cargoes were classified as follows in the official returns:—

| Ship | | Tons register | Freight Carried Tons weight | Tons measurement | Crews |
|---|---|---|---|---|---|
| British | 2603 | 4,530,256 | 1,306,822 | 254,373 | 165,078 |
| Canadian | 2,803 | 718,490 | 202,939 | 1,449,054 | 44,594 |
| Foreign | 4,132 | 2,211,605 | 1,454,787 | 538,499 | 88 093 |
| Totals | 8,284 | 7,016,295 | 2,396,915 | 1,740,045 | 295,965 |

The corresponding figures for ships entered outwards for sea carrying cargoes were:—

| Ship | | Tons register | Freight Carried Tons weight | Tons measurement | Crews |
|---|---|---|---|---|---|
| British | 2,533 | 4,258,960 | 2,706,334 | 714,085 | 136,614 |
| Canadian | 3,557 | 1,041,053 | 616,248 | 291,480 | 45,658 |
| Foreign | 4,132 | 2,211,605 | 1,454,787 | 538,499 | 88,093 |
| Totals | 10,222 | 7,511,618 | 4,777,369 | 1,544,064 | 270,365 |

Taking the combined over-sea traffic inwards and outwards, is employed 18,506 ships of 14,528,000 tons, whose cargoes aggregate 7,174,000 tons dead-weight and 3,284,000 measurement tons, the crews exceeding 576,000 officers and men.

Of the 2,603 British ships entered there came from Great Britain 852 ships of 3,392,000 tons, carrying as cargoes over 860,000 tons dead-weight and 153,600 tons measurement; while there came from British Colonies 399 ships of nearly 381,000 tons, carrying cargoes of 236,000 tons dead-weight and 44,000 tons measurement. Of the 2,533 British ships entered outwards there proceeded to Great Britain 732 ships of 2,529,000 tons, carrying cargoes of 1,635,000 tons dead-weight and 509,000 tons measurement; while there sailed for British Colonies 648 ships of nearly 400,000 tons, carrying cargoes of 259,000 tons dead-weight and 76,500 tons measurement.

It will be seen, therefore, that the British ships entered inwards carrying more than 54 per cent. of the total dead-weight cargoes and 14½ per cent. of the measurement goods, while foreign ships carried about 37 per cent. of the dead-weight and rather more than 2 per cent. of the measurement goods. British ships entered outwards carried more than 56 per cent. of the total dead-weight, and more than 46 per cent of the measurement; whereas foreign ships carried only about 30 per cent. of the dead-weight and not quite 35 per cent. of the measurement.

The trade from and to ports in the British Empire amounted to 45 per cent. of the grand total dead-weight freight; and ships carrying the British flag—excluding Canadian vessels—carried about 56 per cent. of the grand total dead-weight, and nearly 30 per cent. of the measurement goods. Including Canadian vessels, the British Empire can claim possession of 67½ per cent. of the total dead-weight, trade and 82½ per cent. of the measurement goods. The average tonnage per ship for the British was about 1,700 tons; for the Canadian vessels less than 300 tons; for the foreign ships a little more than 900 tons.

It may be interesting to add a few figures showing the magnitude of the coasting trade of the Dominion. In 1908 there arrived and departed 104,527 steamers aggregating nearly 42,857,000 tons, and 50,710 sailing ships aggregating 7,673,000 tons. The sailing ships included nearly 50,200 small schooners, sloops, barges, canal boats, etc., averaging about 150 tons each. The grand totals for the coasting trade were 155,237 ships of 50,530,000 tons, and of these 151,873 ships of 47,356,000 tons were classed as British in the official returns. It will be obvious that great importance must attach to every detail of the business involved in carrying on a shipping trade of the magnitude indicated by the foregoing figures, and still more is this the case in regard to the immensely greater transactions of British shipping considered as a whole. No pains must be spared in promoting economy or improving procedure, and even minute savings on particular items must be secured, since their aggregate effect may be of vast amount.

Since the introduction of iron for the structures of ships and of steam as the propelling power marvellous economies have been effected in the cost of over-sea transport. The chief causes contributing to this result have been (1) improvements in steam machinery, leading to great reductions in coal consumption, (2) considerable enlargements in the dimensions of ships, and (3) the supersession of iron by steel for structures and machinery. It is unnecessary, and would be impossible on this occasion, to deal in any detail with these matters, which have been illustrated repeatedly by many writers, including the speaker. On the other hand, it would be improper to leave altogether without illustration the remarkably low cost of sea transport under existing conditions, since it has great influence on the commerce of the British Empire and of the world.

Rates of freight, of course, vary greatly as the conditions of trade and the stress of competition change. At the present time these conditions remain unfavourable, although it may be hoped that there are signs of improvement, after long and severe depression. It will be preferable, therefore, to give facts for more normal circumstances, such as prevailed five or six years ago. Coal was then carried from the Tyne to London (315 miles) for 3s. 3d. a ton; to Genoa (2,388 miles) for 5s. a ton; to Bombay (6,358 miles) for 8s. 6d. a ton, including Suez Canal dues. The corresponding rates of freight were .111, .025, and .016 of a penny per ton-mile.

Grain was brought across the Atlantic for 9d. per quarter in large cargo steamers, whereas in former times, when it was carried in small vessels, the charge was 9s. 6d. Goods were carried 6,400 miles eastward via the Suez Canal in tramp steamers at an inclusive charge of 25s. to 30s. a ton, the freight rate averaging about .05 of a penny per ton-mile. It was estimated at that time that the average railway rate per ton-mile in Great Britain for cost of transport and delivery of goods was about thirty times as great; but the moderate distances travelled, local and national taxation, high terminal charges, and the immense outlay involved in the construction, equipment, and maintenance of railways account for much of the great difference in cost of transport. The ocean furnishes a free highway for the commerce of the world.

Economy of fuel-consumption has played a great part in the reduction of working expenses in steamships. Fifty years ago from four to five lbs. of coal per indicated horse-power represented good practice in marine engineering for screw steamships. At present, with quadruple expansion engines, high-steam pressures, and more efficient reciprocating engines from 1¼ to 1½ lb. is common practice, and better results are claimed in some cases. A cargo steamer of the tramp type, carrying 6,500 tons dead-weight, can cover about 265 knots in twenty-four hours in fair weather for a coal consumption of 27 tons per day, representing an expenditure on fuel of £20 to £25. A larger vessel carrying about 12,000 tons dead-weight, driven by engines of similar type, would consume about 45 tons in covering the same distance at the same speed. This increased economy in fuel per ton-mile is the result of an increase in dimensions from 365 feet length, 47 feet breadth, and 24½ feet draught of water to a length of 470 feet, breadth of 60 feet, and a draught of 27½ feet. The first cost of cargo steamers is small in relation to their carrying capacity and possible earnings; varying,

of course, with the current demand for new steamships. In the present depressed condition of shipping, about £5 10s. per ton dead-weight is named as a current rate; in busy times the price may be 40 to 45 per cent. higher; even then it is small in proportion to earning power. Working expenses are kept down also by the use of efficient appliances for rapidly shipping or discharging cargoes, and so shortening the stay of ships in port. As an example a case may be mentioned when a ship of 12,000 tons dead-weight and 800,000 cubic feet measurement capacity had her full cargo discharged at an average rate of 300 tons an hour, a fresh cargo put on board at the rate of 250 tons an hour, and 1,600 tons of coal shipped between 7 a.m. on Monday and noon on the following Friday—that is, in 101 hours. In another case a cargo weighing 11,000 tons was discharged in 66 hours. "Quick dispatch" in dealing with cargo is now universally recognized as essential, and it has been asserted that a saving of one day in discharging or loading a tramp steamer when she finds full employment may involve an expense equal to 1 per cent. on her first cost.

The "intermediate" type of steamer in which large carrying capacity is combined with provision for a considerable number of passengers and moderate speed—is of comparatively recent date, but it has been developed rapidly and is subject to the universal laws to which all classes of shipping conform. Increase of size is adopted in order to favor economy in working and greater earning power, while increase in speed is made in some cases. Vessels like the "Adriatic" or "Baltic" of the White Star Line, the "Carmania" and "Caronia" of the Cunard Line, and the "George Washington" of the Hamburg American Line illustrate this statement; while its latest and greatest examples are found in the two steamers now building for the White Star Line by Messrs. Harland & Wolff, which are said to be 45,000 tons, to be intended to steam 20 to 21 knots, to provide accommodation for a great number of passengers, and to have large capacity for cargoes. In mail and passenger steamers of the highest speed increase in dimensions is devoted chiefly to provision for more powerful propelling apparatus and for a correspondingly large quantity of fuel, and the cargo-carrying capacity is relatively small; but the law of increase in size and cost is obeyed, and will be followed up to the limit, which may be fixed by the vast outlay necessary in order to provide suitable harbours and dock accommodation with an adequate depth of water, or by commercial considerations and the possibility of securing a suitable return on the large capital expenditure. Growth in dimensions of ships will not be determined by the naval architect and marine engineer finding it impossible to go further, for there are even now in view possibilities of further progress if the shipowner so desires. Invention and improvement have not reached their ultimate limits.

The wonderful progress made during the last seventy years is well illustrated by the history of shipping trading between Canada and Great Britain, and it may be of interest to recall a few of the principal facts. For a long period trade and communications were carried on by wood-built sailing ships, many of the finest being Canadian built; but at a very early period Canadians had under consideration the use of steamships. One of the first steamers to cross the Atlantic was the ".Royal William" paddle-steamer, built near Quebec in 1831. She was 160 feet long, 44 feet broad, of 363 tons burden, sailed from Quebec on August 5, 1833, and reached Gravesend on September 16, a passage of more than forty days, in the course of which sail-power was largely used. Cabot, in 1497, crossed in the good ship "Matthew," of 200 tons burden, which was probably from 90 to 100 feet in length; so that three centuries of progress had not made very great changes in size of the ships employed. Wood was still the material of construction, and sails were still used as a motive power, although the steam-engine was installed. In 1839 it was a Canadian, Samuel Cunard, who secured—in association with two British shipowners, Burns and McIver—the contract for a monthly transatlantic service from Liverpool to Halifax and Boston. The four steamers built were wood-hulled, driven by padle-wheels, had good sail power, and were of the following dimensions: 207 feet long, 34½ broad, 1,150 tons burden, and about eight knots speed. A rapid passage to Boston then occupied about fourteen days.

Another Canadian enterprise, the Allan Line, started about fifty-six years ago. The first steamer built for the company was appropriately named the "Canadian." At the time of her construction she ranked among the most important mercantile steamers in existence, and was quite up to date. Her dimensions were: Length, 278 feet; breadth, 34 feet; burden, 1,873 tons. She had inverted direct-acting engines, driving a screw propeller, and a full sail equipment.

The Tranatlantic service to New York, as was natural, rapidly surpassed that to Canadian ports, but the latter has been continuously improved, and its development has been marked by many notable events. For example, the Allan Line was amongst the first to use steel instead of iron for hulls, and in their two largest steamers now in service, dating from 1903, they were the first to adopt steam turbines for ocean-going ships, although their lead of the Cunard Company was not long. The "Virginian" and "Victorian" are 520 feet long, 60 feet broad, of 10,750 tons, and their maximum speed is 18 knots. The Canadian Pacific Railway authorities added shipowning to their great land enterprises at an early period in their career by building for the Pacific service in 1891 three important steamers, each 456 feet long, 51 feet broad, of 5,050 tons, and 17 knots speed. These vessels continue on service, and have done splendid work as a link in the "all red" route. Since this step was taken the Canadian Pacific Railway has become possessed of a large fleet of Atlantic steamships, and quite recently has placed on the service from Liverpool to Quebec passenger steamships nearly 550 feet in length, 60 feet in breadth, of 14,200 tons, with a maximum speed of 20 knots.

The latest addition to the Canadian service has been made by the White Star Line in the form of two steamers, the "Laurentic" and "Megantic," of 15,000 tons, 550 feet long, about 67 feet broad, and 17 knots speed. In the "Laurentic" an interesting experiment has been made—Messrs. Harland & Wolff having introduced a combination of reciprocating engines and a low-pressure turbine. This system was patented as long ago as 1894 by Mr. Charles Parsons, to whom the invention of the modern steam turbine and its application to marine propulsion are due. Mr. Parsons foresaw that while the turbine system would prove superior to reciprocating engines in ships of high speed and with a high rate of revolution, there would be a possibility of getting better results by combining reciprocating engines with low-pressure turbines in ships of comparatively slow speed, where a low rate of revolution for the screw-propellers was necessary to efficient propulsion. His main object, as set forth fifteen years ago, was to "increase the power obtainable by the expansion of the steam beyond the limits possible with reciprocating engines," and subsequent investigarians led Mr. Parsons to the conclusino that it would be possible to secure an economy of 15 to 20 per cent. by using the combination system as compared with that obtainable with efficient types of reciprocating engines. Many alternative arrangements have been designed for combining reciprocating engines with low-pressure turbines; that now under trial associates twin-screw reciprocating engines, in which the expansion of the steam is carried down to a pressure of 9 to 10 lbs. per square inch when working at maximum power, and then completed to the condenser pressure in a turbine. Triple screws are employed, the central screw —driven by the turbine—running at a higher rate of revolution than the side screws, which are driven by the reciprocating engines. The "Laurentic" has been but a short time on service, and few particulars are available of her performances as compared with those of her sister ship, fitted with reciprocating engines. It has, however, been reported that the results have proved so satisfactory that the combination system will probably be adopted in the two large White Star steamers of 45,000 tons now building at Belfast. This favourable view is fully confirmed by the performances

of the "Otaki," built by Messrs. Denny, of Dumbarton, for the New Zealand Shipping Company, and completed last year. That firm, as is well known, have taken a leading part in the application of the Parsons type of steam turbine to the propulsion of mercantile and passenger steamers, and they possess exceptional experience as well as special facilities for the analysis of the results of trials of steamships, having been the first private firm to establish an experimental tank for testing models of ships and propellers on the model of that designed by Mr. W. Froude and adopted by the Admiralty. Messrs. Denny have generously placed at the disposal of their fellow-shipbuilders the principal results obtained on the official trials and earliest voyages of the "Otaki," and have compared them with similar results obtained in sister ships fitted with reciprocating engines.* The "Otaki" is the first completed ship fitted with the combination system and subjected to trial on service, and as the successful application of that system to cargo steamers and steamers of the intermediate type would result in a considerable economy in the cost of oversea transport, it may be of interest to give some details of her recorded performance. She is 465 feet long, and 60 feet broad, and of 7,420 tons (gross). Her dead-weight capability is about 9,900 tons on a draught of 27 feet 6 inches, and the corresponding displacement (total weight) is 16,500 tons. The vessel was designed for a continuous sea-speed of 12 knots when fully laden, and the contract provided for a trial speed of 14 knots with 5,000 tons of dead-weight on board. The trials were accordingly made at a displacement of about 11,700 tons. Her installation of boilers is identical with that of her sister ship, the reciprocating-engined twin-screw steamer "Orari," which is 4 feet 6 inches shorter than the "Otaki," but generally of the same form. On the measured mile the "Otaki" obtained a speed of 15 knots, while the "Orari" reached 14.6 knots. In order to drive the "Orari" at 15 knots about 12 per cent. more horse-power would have been required, and this is a practical measure of the superiority of the combination system over the reciprocating twin-screw arrangement in the "Orari." The total water consumption per hour of the "Otaki" at 15 knots was 6 per cent. less than that of the "Orari" at 14.6 knots. If the "Otaki" also ran at 14.6 knots, the water consumption would have been 17 per cent. less than that of the "Orari" at the same speed. On the voyage from Liverpool to New Zealand the "Otaki" averaged about 11 knots, which would have required on the measured mile only about 40 per cent. of the power developed when running 14.6 knots. With the ship laden more deeply, the average development of power on the voyage was about one-half the maximum developed on the measured mile, and this was disadvantageous to economy in the combination. Even in these unfavourable conditions the "Otaki" realized an economy in coal consumption of 8 per cent. on the voyage from Liverpool to New Zealand and back as compared with her reciprocating-engined sister ship; this represents a saving of about 500 tons of coal. Ordinarily the ship would leave England with sufficient coal on board for the outward passage, so that 250 tons less coal need be carried and a corresponding addition could be made to cargo and freight-earning. Probably as experience is gained the actual economy will prove greater than that realized on the maiden voyage; but even as matters stand there is a substantial gain, and a prospect of the extended application of the steam turbine to vessels of moderate and low speed. In view of results already obtained, the New Zealand Shipping Company have decided to apply the combination system to another vessel just ordered from Messrs. Denny.

In designing turbine machinery for vessels of moderate or low speed there must necessarily be conflicting claims. For maximum efficiency in steam turbines a high rate of revolution is necessary; whereas at moderate or low speeds it is antagonistic to propeller efficiency to run at this high rate of revolution. Engineers are at present much occupied with the study of arrangements by means of which these conflicting claims may be harmonized and greater total efficiency of propulsion obtained. Having regard to the enormous capital invested in cargo steamers of moderate speed, and the importance attaching to their economic working as influencing the cost of oversea transport, it will be obvious that it is most desirable to find an arrangement in which the high speed of the rotor may be reduced by means of some form of gearing or its equivalent, so as to enable the screw shaft and its propeller to be run at a speed which will secure maximum propeller efficiency. Many proposals have been made, including mechanical gearing and hydraulic or electric apparatus for transforming the rate of motion. Some of these are actually undergoing experimental trials, and are said to have given very promising results. One of the most important trials is that undertaken by the Parsons Marine Steam Turbine Company, which has purchased a typical tramp steamer, and is carrying out on her a series of trials in order first to ascertain accurately what are the actual conditions of steam and coal consumption with the present reciprocating engines, and then to ascertain the corresponding facts when those engines have been removed and a steam turbine with its associated gearing has been fitted. It is interesting to note in passing that in the earliest days of screw propulsion with slow-running engines it was found necessary to adopt gearing in order to increase the rate of revolution of the propellers, whereas at present interest is centred in the converse operation. Furthermore, if any system if gearing-down proves successful it may be anticipated that its application will be extended to swift turbine-driven steamships, since it would enable good propulsive efficiency to be secured in association with rapidly running turbines of smaller size and less weight than have been employed hitherto.

### The Marine Steam Turbine.

The rapid development of the marine steam turbine during the last seven years constitutes one of the romances of engineering, and the magnitude of the work done and the revolution initiated by Mr. Charles Parsons will be more justly appreciated hereafter than it can be at present. In some quarters there is a tendency to deal critically with details and to disregard broader views of the situation as it stands to-day. In May 1909 there were 273 vessels built and under construction in which steam turbines of the Parsons type are employed, the total horse-power being more than three and a half millions. In the Royal Navy every new warship, from the torpedo-boat up to the largest battleships and armoured cruisers, is fitted with turbine engines; and the performances of vessels which have been tested on service have been completely satisfactory, in many instances surpassing all records for powers developed and speeds attained. In the war-fleets of the world this example is being imitated, although in some cases it was at first criticized or condemned. In the mercantile marine as a whole, while the new system has not made equal advance, many notable examples can be found of what can be accomplished by its adoption. It is now admitted that steam turbines enable higher speeds to be attained in vessels of given dimensions; and in steamers built for cross-channel and special services, where high speed is essential and coal consumption relatively unimportant, turbines have already ousted reciprocating engines. For oversea service and long voyages an impression has existed that the coal consumption of turbine-engined ships would considerably exceed those of ships driven by triple or quadruple expansion reciprocating engines. Critics have dwelt on the reticence in regard to actual rates of coal consumption practised by owners of turbine steamships. Naturally there are other reasons for reticence than those which would arise if the coal consumption were excessive; but pioneers in the use of turbine machinery may reasonably claim the right of non-publication of results or trials in the making of which they have incurred large expenditure and taken con-

(Continued on page 256.)

* See a paper by Engineer Commander Wisnom, R.N., in the Proceedings of the Institution of Engineers and Shipbuilders in Scotland for 1909.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**New Brunswick.**

ST. JOHN.—Tenders will be received until 3rd Sept. at noon for the placing of piles at the approaches to the west side dock of the steam ferry in the harbor, according to plans to be seen in the office of William Murdoch, city engineer.

**Quebec.**

RIVER BEAUDETTE.—Tenders will be received until 6th September for the erection of a steel bridge over the River Beaudette, with concrete piers. Fabrien Bissonnete, Secretary-treasurer.

THREE RIVERS.—Tenders will be received until Thursday, Sept. 16th, for supplying and installing pressure filters with a capacity of two million gallons per 24 hours. L. T. Desaulniers, Secretary-treasurer.

THREE RIVERS.—Tenders will be received up to the 16th Sept., for the construction of a reinforced concrete or iron bridge, of 16 feet wide, on Ste. Marguerite Road, to be finished before the 16th Nov. Each tenderer must furnish his plans and specifications. L. T. Desaulniers, secretary-treasurer. City Hall, Three Rivers, 28th Aug., 1909.

MONTREAL.—Tenders will be received up to noon on Tuesday, 14th September for the enlargement of the city's aqueduct, by widening and deepening the same on a length of about 27,300 feet. The work comprises about 1,176,000 cubic yards of earth excavation and about 400,000 cubic yards of rock excavation, also the formation of the slopes and banks of the widened aqueduct, the transporting to a distance of excess of excavated material, the construction of syphon culverts, the construction of dry stone wall lining in the slopes, etc., etc., the whole according to plans, cross-sections and specifications, to be obtained from George Janin, superintendent and chief engineer of the Montreal Waterworks, City Hall. (Advertised in Canadian Engineer.)

**Ontario.**

LEAMINGTON.—Tenders for electric wiring and fittings for the Public Building, will be received until Thursday, September 16. G. Roach, Clerk of Works, Leamington; T. A. Hastings, Clerk of Works, Customs House, Toronto. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

FENWICK.—Tenders for building public school will be received up to Friday, Sept. 10th. Plans to be seen at the office of Charles M. Borter, Niagara Falls South, Ont. B. A. Pattison, Secretary of Public School Board.

HAMILTON.—Tenders will be received up to Sept, 3rd for constructing pipe sewers, according to plans and specifications, which can be seen at the office of the city engineer. S. H. Kent, city clerk.

NIAGARA FALLS.—Tenders are being called for one thousand feet of nine-inch sewer and fourteen hundred feet of eighteen-inch sewer. J. C. Gardiner, B. A. Sc., City Engineer.

PRESCOTT.—Tenders will be received up to September 11th, 1909, for the delivery of the coal required at the lighthouse Depot, Prescott, Ont., during 2 years. The coal must be first-class bituminous screened steam coal. The quantity required will be about 1,800 tons. G. J. Desbarats, Acting Deputy Minister of Marine and Fisheries.

TOTTENHAM.—Tenders for boring and piping an artesian well will be received up to the 7th September. Separate quotations required for a 4, 6 and 8-inch pipe. A. P. Potter, Reeve.

TORONTO.—Tenders will be received until Tuesday, Sept. 7th, for 15 tons of copper conductor. (Advertised in the Canadian Engineer).

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, October 4th, for erecting the Wilton Avenue Bridge. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Tuesday, 5th October, for 1,080 lengths of 16-inch cast iron pipe and 16-inch valves. Joseph Oliver, mayor. C. H. Rust, city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders are invited until Tuesday, Sept. 7th, for construction of asphalt, vitrified block, brick and bitulithic pavements, concrete curbs, concrete walks and sewers. Joseph Oliver, mayor. C. H. Rust, City Engineer.

TORONTO.—Tenders will be received up till Sept. 14th, for all the various trades required in the erection and completion of an 8-storey fireproof building on the south-east corner of King and Jordan Streets, Toronto, for the Standard Bank. Darling & Pearson, 2 Leader Lane, Toronto, architects.

THOROLD.—Tenders will be received until 5 p.m. Tuesday, September 7, 1909, for the construction of 1,290 feet of 18-inch tile sewer and all appurtenances. D. J. C. Munro, Town Clerk. Norman D. Wilson, Engineer, Logan Building, Niagara Falls, Ont.

VICTORIA HARBOR.—Tenders will be received up to September 7 for the brick work on the power house at the C.P.R. elevator, amounting to about 325,000 brick. All material and water will be furnished by the Company. Contractors to furnish labor only. John S. Metcalfe Co., Victoria Harbor, will furnish plans and specifications.

WHITNEY.—Tenders will be received until Wednesday, September 8th, for the erection of a steel bridge on stone abutments across the Madawaska River. H. F. McNaughten, Secretary Department Public Works, Toronto.

**Saskatchewan.**

HANLEY.—Tenders will be received for the construction of about 25 miles of metallic circuit, rural telephone line in the Hanley district, to be constructed as soon as possible. Hanley Rural Telephone Co., W. E. Hall, secretary.

SASKATOON.—Tenders will be received until Wednesday, September 22nd, for the construction of a subway under the tracks of the C.N. Ry. here. Geo. T. Clark, City Engineer. J. H. Trusdale, City Clerk. (Advertised in The Canadian Engineer).

MOOSEJAW.—Tenders will be received until Monday, Sept. 6, for 1—72" x 20' Robb-Mumford Boiler, complete with smoke connection, containing 161—3" tubes. 2—66" x 14' Water Tube Boilers each with 72—3½" tubes. 1—D. D. Pemberthy Injector. 1—Small Boiler Feed Pump. John D. Simpson, City Clerk. J. Darlington Whitmore, City Engineer.

**British Columbia.**

CRANBROOK.—Tenders will be received by the Cranbrook Electric Light Co. for (1) boilers, (2) engines and (3) electrical equipment generally.

VANCOUVER.—Tenders will be received up to Monday, September 6th, for grading and bridging of the Alberni branch of the Esquimalt and Nanaimo Railway Company from the 108th mile to Alberni (27½ miles). See Mr. Bainbridge, Division Engineer E. & N. Railway, Victoria; Mr. H. J. Cambie, Chief Engineer, E. & N. Railway, Vancouver, for plans, etc. R. Marpole, vice-president.

VICTORIA.—Tenders are invited until September 15 for the supply of about nine hundred tons of cast iron socket pipes and special castings. T. Lubbe, secretary, Esquimalt Waterworks Company.

NEW WESTMINSTER.—Tenders will be received by the Hon. the Minister of Public Works up to 11th September, for the erection and completion of a new highway floor system over the bridge across the Fraser River. F. C. Gamble, Public Works Engineer, Public Works Department, Victoria.

## CONTRACTS AWARDED.

**New Brunswick.**

ST. STEPHEN.—Hon. John Morrissy has awarded the contract for the Maxwell Crossing bridge at St. Stephen to Frank L. Boone, of Gibson, the contract price being about $1,600.

**Ontario.**

BADEN.—The Hamilton Bridge Co. have secured a contract at $2,297, for the erection of a new steel bridge, abutments, arch culvert, etc.

BERLIN.—The Berlin Light Commission held a meeting on Friday, at which the tenders for machinery necessary for the distribution of Niagara power were received from the Canadian General Electric Co., Toronto, the Canadian Westinghouse Co., Hamilton, the Bullock Electric Co., Buffalo; the Canadian Fairbanks Co., Montreal, and the Western Electric Co., Chicago. After a careful comparison, it was found that the figures of the Canadian General Electric Co., and the Westinghouse Co., were the lowest, and the Commission decided to accept the lowest tender for each of the items in the specifications. The tenders were divided as follows:—No. 1, Rotary Converter, three transformers and switchboard—Canadian Westinghouse Co., $5,748. No. 2, 3 transformers, 100 k. w., Canadian General Co., $2,760. No. 2, 3 transformers, 150 k. w., Canadian Westinghouse Co., $2,748. No. 4 and 5, Switchboard panel, Canadian General Electric Co., $1,118. No. 6, 7 and 8, Frequency changer set and switchboard, $7,400. No. 9, Switchboard, Canadian Westinghouse Co., $595. No. 10, 3 transformers, 200 k. w., Canadian General Co., $927.60. All the machinery must be shipped to Berlin and ready to be installed inside of four months.

COBALT.—The contract for cast iron pipe and special castings has been awarded to the Canada Foundry, at $7,842.40; for steel stand pipe to the Canada Foundry at $2,540.00; for vitrified tile pipe and junctions to the Toronto Sewer Pipe Co., for $1,800.00; cast iron manhole covers to the London Foundry Co., at $526.50, and the contract for labor and certain materials for the construction of waterworks and sewers to Wm. Newman & Co., Winnipeg, Man., at $38,584.10

LINDSAY.—Mr. William Henley will make proposed alterations to the Collegiate Institute for $13,960.

NIAGARA FALLS.—The Westrumite Co., of Brantford, Ont., have been awarded the contract for 4,000 sq. yds. of paving at $2.20 per sq. yd. and 2,800 lineal feet gutter, at 55 cents per lineal foot. J. C. Gardner, B. A. Sc., City Engineer.

TORONTO.—The contract for a reinforced concrete bridge over the Humber River between Purpleville and Kleinburg, has been awarded by the Vaughan Council to Contractor Hicks, at $3,600. The structure will be 16 feet above the water and will have a span of 50 feet. Mr. Frank Barber, York County Engineer, Toronto, prepared the plans.

**British Columbia.**

VICTORIA.—A a recent meeting of the city council the purchasing agent and the water commissioner submitted a report on the tenders recently received for gate valves and cast-iron pipe. In connection with the offer of J. H. B. Rickaby, for Mannesman weldless steel tubes, a committee will pass on the merits of this particular tender. The tender for valves will be awarded to A. J. Forsyth & Co., of Vancouver, at $2,759.50. The lowest tender for cast-iron pipe was that of R. Angus, at $48,969, and for pig lead, Robertson, Godson & Co., at 3.45 per pound. Mr. Rickaby's tender for the same quality of cast-iron pipe was $9,394 less than Mr. Angus', while the weight of the tubes is 483 tons, compared with 1,346 tons of the cast-iron pipe. Here are tenders for cast-iron pipe: R. P. Rithet & Co., $50,930; W. G. Winterburn, $49,892; Stavely Coal & Iron Co., $49,592; Robertson, Godson & Co., Vancouver, $50,131; A. Rickaby, $44,190; Robert Ward & Co., $51,191; R. Angus, $48,969; Findlay, Durham & Brodie, $51,776; M. & L. Samuel Benjamin Company, $54,381.

## LIGHT, HEAT, AND POWER

**Ontario.**

GOW GANDA.—The first electric light plant at Gow Ganda will be ready in a few days on the Bartlett Mines, thus enabling it to operate its staff in two shifts, night and day.

KINGSTON.—The city council has appointed Robert A. Ross, of the firm of Ross and Holgate, consulting and supervising engineers, Montreal, as the city's experts in the arbitration asked for the Street Railway Company to determine the cost of power provided the company from the city plant.

RENFREW.—Mr. John B. McRae, consulting engineer, of Ottawa, has been engaged by the town of Renfrew, Ont., to make a report on the advisability of installing a plant for the development of the water power recently purchased by the town.

LONDON.—In connection with the installation of Niagara power, the idea of underground transmission wires was favored at a meeting of the Council, held on Tuesday. Estimated cost, $70,000.

ST. CATHARINES. — Ridgeville Electric Light and Power Company, Ltd., has just been formed, and its capitalized at $40,000. The object is to supply electric light and power to places in the townships of Thorold, Pelham and Gainsboro. A franchise has been obtained in the two townships first named. Behind the company are Geo. Arnold, Ridgeville; Hugh A. Rose and Frank W. Houston, Welland; J. C. Stoat, Fenwick, and H. S. Arnold, Toronto.

TORONTO. — The Consolidated Electric Co., Limited, announce that they are now permanently located at 120 Queen Street East.

**Alberta.**

CALGARY. Over twenty new street lights were put up in ward four by the city light department last week. The majority of the lamps were arclights, but a few were Tungsten incandescents.

**British Columbia.**

VICTORIA.—The final plans for the Coquitlam Dam to be constructed by the Vancouver Power Company, Ltd., have been filed. The Executive Council will meet on Wednesday, September 1st for final decision in the matter.

## CEMENT—CONCRETE.

**Quebec.**

RIVER BEAUDETTE.—Concrete will be the material used for the piers of a bridge for whose construction tenders are now invited by Fabien Bissonette, secretary-treasurer.

**Ontario.**

BADEN.—A new bridge with concrete floor will be erected here by the Hamilton Bridge Co., for $2,297. H. J. Bowman is county engineer.

ST. CATHARINES.—Whether or not the construction of numerous concrete walks will be commenced this year is to be decided by the council at a meeting on the 13th inst.

STRATFORD.—An option has been secured by the National Cement Co., Durham, on Horseshoe quarries, St. Mary's, and it is expected that the Durham company will take over the quarries upon the expiration of the present lease, held by St. Mary's men. The intention is that stone will be shipped to Durham and there manufactured into cement.

TORONTO.—On Tuesday, Sept. 7th, a meeting will be held to hear appeals in connection with proposed local improvements, which include concrete sidewalks, sewers, pavement and gutters.

TORONTO.—A reinforced concrete bridge, with a span of 50 feet, will shortly be erected over the Humber, on the 8th concession, Vaughan Township. Mr. Hicks secured the contract at $3,600. Mr. Frank Barber, York County Engineer, prepared the plans.

PETERBOROUGH.—George A. Begg & Company, of St. Catharines, will probably build the new reinforced concrete bridge here at a cost to the municipality of $28,699.

**British.**

LONDON (ENG.).—It is understood that £1,000,000 preference shares in the cement combine have been underwritten for issue. Later, bonds will be allotted as payment to the groups entering the combine.

## FINANCING PUBLIC WORKS.

**Quebec.**

'JOLIETTE has sold $200,000 debentures to Hanson Bros., of Montreal.

COATICOOK.—The ratepayers have authorized the borrowing of $14,000 for a new dam, a new power house and new electrical plant.

NOTRE DAME DE GRACE.—Tenders will be received till September 7th, for $50,000 debentures, the proceeds of which are to be used for the opening and widening of streets. L. Descarris, secretary-treasurer, Notre Dame de Grace.

THREE RIVERS.—Bids are invited for the construction of a reinforced concrete bridge, 16 feet wide, by L. T. Desauliners, secretary-treasurer.

**Ontario.**

ARNPRIOR has sold $2,506 debentures to S. A. Stimson & Company, of Toronto.

CHIPPEWA.—On September 22nd the ratepayers will vote on a by-law connected with the establishment of an electric smelting concern.

LONDON.—The City of London will shortly have $400,000 in debentures for sale. The Niagara Power bonds aggregating $235,000 have not yet been sold.

ORILLIA.—The Town Council offered to loan the Tudhope Carriage Company $50,000 upon learning of their decision to rebuild here.

VICTORIA.—On August 26th the ratepayers passed a by-law to enter into an agreeement with the British Columbia Electric Company relative to the development of power on the Jordan River. The company will spend $1,500,000. The proposition to expropriate the Esquimalt Waterworks Company's agreement was turned down.

**British Columbia.**

PEACHLAND.—This municipality offers for sale until September 13 $9,500 waterworks debentures, $7,300 electric light debentures, $3,000 road debentures, and $1,000 5 per cent. s.-a., 20-year fire protection debentures. H. McDougall is the clerk.

VANCOUVER.—The ratepayers may vote on a by law to purchase the water rights of the Burrard Power Company. They may also vote on a Great Northern Railway by-law this fall.

## SEWERAGE AND WATERWORKS.

**Ontario.**

PETERBOROUGH.—The city Board of Works have recommended the acceptance of the tender of George A. Begg & Co., of St. Catharines, for $28,699, for building a reinforced concrete bridge over the river at Smith street.

**Manitoba.**

PORTAGE LA PRAIRIE.—Messrs. Smith, Kerry & Chace, of Winnipeg and Toronto, are making a report on the advisability of constructing a dam or a water-wheel in connection with the waterworks here.

**Alberta.**

CALGARY.—The water mains have now been laid through the tunnel under the Bow and the gravity system will be connected with the Hillhurst mains this week. For some time a water supply has been kept up by a pipe line over the Louise Bridge, but this will be disconnected now that the mains under the river have been laid.

EDMONTON.—Work is now in progress on the laying of the new water main from the power house up Second street to the north end of the city. The main has been completed as far north as Saskatchewan Avenue. Below the hill steel pipe will be laid, and above, the pipe will be of galvinized iron. This pipe will be the largest in the city and will be the source of supply for the G. T. R. yards.

**British Columbia.**

FERNIE.—Messrs. Broley and Martin, the contractors who, under the supervision of the city engineer, Mr. Potter, are putting in the pipe line to carry water from Fairy Creek to the city, are making good progress with the work. The pipe is being laid from the town end of the ditch and a considerable portion is now in the ground. The bridge over the Elk River is progressing, but at the present time the contractors are having considerable trouble with the logs brought down by the river, and which by piling up against the false work of the bridge, would, unless helped on their way by pike poles and peavies, injure it. The centre pier is not quite finished, but as soon as this is done it will be only a comparatively short job to lay the stringers and complete the work.

## RAILWAYS.

**Foreign.**

CHICAGO.—The Northern Pacific recently received 13 new locomotives from the Baldwin Works and 17 more have been ordered. They are all of the Pacific passenger type, and those received have been assigned to passenger service on the various divisions. The combined weight of each engine, with its loaded tender, is 376,000 pounds, the tenders having a capacity of 12 tons of coal and 7,000 gallons of water. The engines have a 22 by 26-inch cylinder and 69-inch drivers. They are capable of an average speed of 60 miles an hour with a train of 8 cars. In the North Coast Limited service a speed of 70 miles an hour and over is often made for considerable distances.

INDIANAPOLIS.—Contracts for the improvement and reduction of grades on the Vincennes division for the Pennsylvania line in Indiana have been let to Charles H. Stevens & Son, of Cleveland. The contract calls for the completion of the work in 90 days.

## TELEPHONY.

**Ontario.**

WATERLOO.—The establishment of an independent system of telephones is being discussed by the Waterloo Board of Trade.

**Manitoba.**

WINNIPEG. — The extension of the Government telegraph lines north from Athabasca Landing to Lesser Slave Lake is expected to reach the lake this fall. The right-of-way has been cleared and the poles have been erected.

WINNIPEG.—A complete change in the method of the management of the Manitoba Government telephone has been decided on. The arrangement will be similar to the arrangement by which railway companies are governed, the business being divided into several departments, each of which is independent of the others. The province will be divided into districts. The management will be under three heads—commercial agent, superintendent of plant, and superintendent of service. One important new post will be created, that of general superintendent of plant for the province.

**British Columbia.**

VICTORIA.—A telephone connection with Strawberry Vale has been decided on. The Telephone Company has agreed to commence work immediately.

## MARKET CONDITIONS.

Montreal, September 2nd, 1909.

Advices from the United States confirm the prediction that records might be broken, presently, in the pig iron production of that country. It is claimed that the production last week sets a new high record, exceeding even that of 1907, which has hitherto been referred to as the high record year. In addition to the activity thus indicated in the pig iron trade, huge orders for steel rails are now being placed, for delivery next year. Other railway material, such as steel frogs and switches, are being ordered in very large quantities, and one company has just booked an order for 16,000 tons of structural steel for bridge work. There is consequently every reason to look forward to an increasingly active season. Steel bars are now quoted at a minimum of $1.35 per 100 lbs., Pittsburg, structural steel being $1.40, with a tendency to higher prices for future delivery. Bessemer, this year's delivery, is quoted at $16.50, Valley, being an advance of about 50c. recently, large quantities having been sold at the higher figure. For delivery for the first half of next year, the price is $17, these being minimum prices. Basic pig is now quoted at $15.25, but is expected to advance immediately. No. 2 foundry has been dealt in at $16, Valley, and as high as $16.25 has been paid. Foundry iron is difficult or impossible to obtain at less than $15.25, furnace.

Mail advices just received from Glasgow, refer to an advance of 1s. 6d., and say that a very large business has been done in pig at the advance mentioned. Shipments are showing a very considerable increase. Malleable iron castings have advanced 7s. 6d. per ton.

Locally, demand is good, generally speaking, for pig iron, and demand for castings and for general material is also better, it is claimed. Consumers are buying for fall and winter delivery, and it is expected that some good, big orders will be booked in the next ten days. There is a decided scarcity in the hands of smaller people, and even importers, who usually carry small lots around their warehouses, have been entirely cleaned out lately, owing to the demand from small consumers. Prices are advancing slightly from time to time as a result. If the English and Scotch markets continue to advance, as they have been doing, corresponding advances will be made for delivery here.

Prices of finished and semi-finished material have been about steady here during the past week, and practically no changes have taken place in the usual list, after the somewhat frequent alterations reported the previous week.

**Antimony**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.90 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; cake, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 13¾ to 14c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 10c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.81; 10-ft., $5.37. Fuses, time, double tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.40; 28-gauge American, $4.75; 30-gauge American, $5.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 15c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50; Midland or Hamilton pig is quoted at $20 to $20.50, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.55 to $3.65.

**Lead Wool.**—$10.5a per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32 to 32½c.

**Zinc.**—The tone is steady, at 5¾ to 6c

* * * *

Toronto, August 26th, 1909.

The now almost certain prospect of good crops in the North-West, the general success of Canadian farmers in securing good prices for their products, are reflected in the earnings in other departments of the country's industry. Business of all kinds is more active and prices are in many cases looking up, metal being a notable example. It is regrettable to learn of the disablement, at a time of increased production and very active orders, of one of the furnaces of the Hamilton Iron & Steel Works. The loss which the company must suffer is placed at a high figure.

In Great Britain, the price of iron for future delivery is advancing, and there is greater buoyancy in the trade. In the United States, as we note elsewhere, there is a genuine improvement, not bolstered by special interests.

Toronto finds business active, especially so in the way of house-building, which is in a great danger of being overdone, if not already so. The Industrial Exhibition promises to be a good one this year, and the retail activity will be thereby increased.

An experienced New York observer says there is every appearance of a sound actual revival in business in the iron and steel trade, which may be expected to grow and spread to other lines. "With the tariff now out of the way, and a bumper crop promised, basic conditions are now sound and promising.". If, it is added, a reduction should come in the shape of a decline from the extravagant prices to which some securities have been forced in Wall Street, it would make very little impression on the generally favorable mercantile position and prospects in the U. S.

In harmony with this prediction of greater general activity, is the appearance of a circular from an important shipping house to its Canadian clients, dated 24th August, which says:

"We beg to advise that there is a serious car shortage impending which the railroad people now regard as certain between the present time and the coming winter, and we inform you of this so you may anticipate your requirements in our line as much as possible, seading in your specifications for immediate and future shipment."

When it is remembered that hundreds of thousands of cars were reported lying idle only a month or two ago, the significance of the announcement is great.

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Toronto, September 2nd, 1909.

An improved demand from the country exists in such goods as building felt and building papers, pitch, tar, and roofing goods. Bricks, too, are active for city trade, but the same cannot be said of cement. In

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ESTABLISHED 1893.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## THE CEMENT MERGER.

It is announced that the $30,000,000 Canadian cement merger has been successfully launched. The final negotiations and legal details have been completed. The companies coming into the new Canadian cement company have made their terms, have accepted the valuation offered them, the underwriters are busy on the security issue, and all that remains to make this new venture a success is to sell the cement manufactured next year at a profit.

We wonder will they, or is there to be repetition of this year's uncertainty in the cement market?

Press despatches state that a "leading official" of the new company placed the yearly output of their mills at 4,500,000 barrels—just one and a quarter million barrels more than the yearly consumption of cement in Canada.

Add to the proposed output of the new company the output of the mills in Canada not included in the merger and the prospective output for 1910 will be double the probable consumption during that period.

And this is not all. The amount of cement imported annually is on the increase. In 1908 it was almost half a million barrels. Because of the unusual conditions attending the cement trade in Canada during this year the imports for 1909 are likely to be larger. Where, then, is this 4,500,000 barrel plant to find its market, and by what means will they sell cement at a profit?

For some years past the consumption of cement in Canada has been on the increase, but we have no guarantee that this increase will long continue. In fact, unless new uses for cement are found there is every indication that the consumption will remain stationary.

The cement industry in Canada since its inception has had financial troubles all its own, and we do not see that this new venture will in any way ameliorate the difficulties under which it has been struggling.

## CANADA'S TIMBER LOSS.

The Forestry Branch of the Interior Department, Ottawa, are doing a good service to Canada in making known the timber loss through forest fires. A knowledge of the loss will impress the necessity of great care with fire.

During the year 1908 835 forest fires of serious proportions occurred in the Dominion, upwards of 188,000 acres were burned over, causing destruction of over 56,000,000 feet, valued, including mills and improvements, at $25,500,000. Twenty-one lives were lost as a result of forest fires (all in British Columbia) and 2,404 persons were thrown out of employment.

Quebec Province headed the list with 250 fires, then British Columbia came second with 235. In Quebec, however, the value of the timber destroyed was very slight. In British Columbia 40,000,000 feet were destroyed at a loss of $25,000,000, or over 90 per cent. of the total loss by fire in Canada.

The destruction by fire in Manitoba and Alberta was very light. In Saskatchewan timber valued at over $20,000 was burned.

The heavy loss in British Columbia was due, of course, to the great fire in the Crow's Nest Pass country,

which destroyed Fernie and entailed a heavy loss of life. Fire on Vancouver Island, it is estimated, caused the destruction of 24,000,000 feet of timber.

Engineers appreciate the loss such fires cause. They should be among the first to show great concern and care, and thus educate those they come in close touch with.

## EDITORIAL NOTE.

Ontario's railway mileage was increased during 1908 by 679 miles. There are now in that Province 8,399 miles of steam road and 119 separate systems.

## PRECIPITATION FOR AUGUST.

The amount of precipitation which fell during August varied greatly with the district. In the southern parts of Vancouver Island and the Central Valleys of British Columbia, throughout Alberta, in most districts of Ontario and locally in Quebec and the Maritime Provinces the amount was much less than the usual quantity, whereas in some of the remaining portions of the Dominion, the positive departure was very marked, especially so in the eastern portion of Quebec, the extreme southwestern portion of the Peninsula of Ontario and also in portions of Prince Edward Island.

In British Columbia, a nearly normal temperature in the south decreased northwards to the Cariboo District, where there were negative departures of from 3° to 7°. In the Peninsula of Ontario, the Ottawa and Upper St. Lawrence Valleys and throughout the Maritime Provinces the average was just, or not quite reached. Elsewhere in the Dominion the average was generally exceeded. Positive departures of from 3° to 5° were recorded from Saskatchewan to northwestern Ontario.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for the monh.

Ten inches of snow is calculated as being the equivalent of one inch of rain.

| Station. | Depth in inches. | Departure from the average of twenty years. |
|---|---|---|
| Calgary, Alta. | 0.60 | — 1.98 |
| Edmonton, Alta. | 0.90 | — 1.06 |
| Swift Current, Sask. | 2.40 | + 0.62 |
| Winnipeg, Man. | 4.70 | + 2.16 |
| Port Stanley, Ont. | 4.20 | + 1.62 |
| Toronto, Ont. | 1.33 | — 1.50 |
| Parry Sound, Ont. | 1.50 | — 1.30 |
| Ottawa, Ont. | 3.20 | + 0.17 |
| Kingston, Ont. | 3.00 | + 0.55 |
| Montreal, Que. | 2.30 | — 1.07 |
| Quebec, Que. | 5.20 | + 1.38 |
| Chatham, N.B. | 4.30 | + 0.29 |
| Halifax, N.S. | 3.40 | — 0.93 |
| Victoria, B.C. | 0.50 | — 0.11 |
| Kamloops, B.C. | 0.60 | — 0.40 |

## UNION OF NOVA SCOTIA MUNICIPALITIES.

The Union of Nova Scotia Municipalities met at Yarmouth, N.S., on Sept. 2nd, the report of the Committee on Resolutions was the first matter taken up. It made two recommendations, namely that voting by ratepayers in incorporated towns on extraordinary expenditures should be by ballot, and that the suggestions, as to improvements in the administration of justice as it affects towns and municipalities should be referred to the incoming executive. Both recommendations were adopted without dissent.

On motion of Arthur Roberts, of Bridgewater, and Mayor Richardson, of Sydney, the meeting decided that towns and municipalities should be given full control over the taxation, and the relicensing of all hawkers and pedlars within their respective limits, and that there should be no special or exceptional legislation in their behalf.

Mayor Stewart, of Bridgewater, read a highly interesting paper on "Municipal Assessment." He sharply criticised the present methods of assessment, mainly on the ground of under valuation, Warden Bishop, of Halifax, and Warden McMahon, of King's spoke upon the subject. On motion Dr. Stewart was cordially thanked for his paper.

The following officers were elected: President—Warden A. E. McMahon, Kings County.

Vice-President—Mayor W. A. Richardson, Sydney.

Secretary—A. Roberts, Bridgewater.

Treasurer—F. W. W. Doane, Halifax.

Executive Committee—T. S. Rogers, K. C., Amherst; Mayor Kelly, Yarmouth; Mayor Chisholm, Halifax; Mayor Murray, Truro; City Solicitor Finlay McDonald, Sydney; County Clerk W. Kerr Dimock, Windsor; County Stipendiary J. L. McDougall, Halifax.

Kentville was decided upon as the next place of meeting, and the convention adjourned.

## ONTARIO MUNICIPAL ASSOCIATION.

The Ontario Municipal Association met in Toronto, Sept. 1st and 2nd, 1909. Forty of the townships, towns and cities of Ontario were represented. In the absence of the president, Mayor W. Kennedy of Owen Sound, the first vice-president, George Geddes, Mayor of St. Thomas, occupied the chair, and made the opening address.

After pointing out that the association is prosperous financially and is holding its own in the matter of membership, he mentioned some of the matters which are to be discussed during the session. He said that a strong committee should be formed to watch, and, if necessary, aid in the amending of the Ontario Municipal Act. He suggested that serious consideration be given the question of federating the various Provincial associations.

### Government by Commission.

"Then, too," he said," "we want legislation allowing smaller cities and towns to choose government by a Board of Control or a commission without having to go through such elaborate stages as are at present necessary. What is just as important, too, is that municipalities should receive at least a portion of the liquor prosecution fines. We have all the trouble and expense of the prosecution."

A letter was read from the Council of Fort William, urging that a law be made preventing corporations from appointing special constables without notifying the municipal authorities or the chief of police of district. The matter was referred to the Committee on Resolutions.

The following resolutions were presented to the meeting and referred to the Committee on Resolutions.

That the legislature be requested to give municipalities the power to elect that the affairs of the community be conducted by a commission appointed by the people for three years and capable as a commission of initiating legislation for the people. Moved by W. C. Mikel of Belleville, and W. H. Ross of Dundas.

### Assessment Matters.

That this association request the Legislature to amend the Municipal Act of 1904 by adding a clause declaring that the courts shall have power to consider the value of property for county purposes, which the assessors of individual municipalities cannot consider. Moved by A. J. Johnston and R. Bailey.

That the Registry Act be amended to provide that plans of sub-divisions of land within three miles of a city of over 25,000 population must be submitted for the approval of the Ontario Railway and Municipal Board before being registered. Moved by Mayor Hopewell of Ottawa, and seconded by Mayor Kyle of Brockville.

W. C. Mikel, K.C., of Belleville, wanted the association to back Winnipeg in asking the Ottawa Government for a grant towards the proposed Winnipeg Fair in 1912.

"You see," said Mr. Mikel, "while one or two million dollars seems a great deal to a young country like ours, still I think a great deal depends on the success of the Fair. It will be probably the greatest exposition Canada has ever had. I don't think anything could be of more benefit to the country."

The association passed the resolution supporting a "liberal" grant to Winnipeg.

"The lawyers in the House are our enemies," said City Solicitor W. B. Doherty of St. Thomas. "They oppose pretty nearly everything we want."

This came as the result of a discussion of the various failures that the association had been forced to record against itself at the hands of the Legislature. It was decided that another effort will be made to have the Municipal Act amended to limit the liability of municipalities for damages for accidents occurring on the highway.

The following officers were elected for 1909-10: President, Mayor George Geddes, St. Thomas; Vice-Presidents, Controller C. A. Hopewell, Ottawa; Controller W. S. Harrison, Toronto; Mayor Kyle, Brockville; County Clerk W. Lane, Huron; Mayor C. C. Hahn, Berlin; Secretary-Treasurer, County Clerk K. W. McKay, St. Thomas; Executive Committee, City Solicitor W. B. Doherty, St. Thomas; City Solicitor W. C. Chisholm, Toronto; City Clerk S. R. Armstrong, Peterboro; City Clerk S. H. Kent, Hamilton; Township Clerk, York; Alderman Jaffray, Galt, and City Solicitor F. R. Waddell, Hamilton.

## NOVA SCOTIA SOCIETY OF ENGINEERS.

The third annual meeting of the Nova Scotia Society of engineers was held in New Glasgow on the 9th and 10th of September, 1909. The following papers were presented.

Some Memoranda on Land Surveying in Nova Scotia—R. R. McKenzie.

Forest Conservation—Prof. Sexton.

Forest Preservation—C. M. Odell.

Relation of Forests to Stream Flow—D. McD. Campbell.

The Timber Asset of Nova Scotia—A. R. McLeave.

On the second day of the Convention visits were made to the McNeil's bridge works and the Nova Scotia Steel Co.'s works. A trip was made down the river to inspect the dredge Northumberland.

President J. H. Winfield in presenting the report of the executive committee, makes the following suggestions:

"If the Society is to continue its existence, and to carry out its aims and objects as laid down in the Constitution, some definite work should be undertaken, and we would suggest the following:—

a. That a systematic effort be made to get together costs and data, and that they be printed and circulated among the members;

b. That if possible, one or two meetings each year should be held at other points outside of Halifax;

c. That the discussions and papers read at meetings should be reported, edited and printed;

d. That at the end of the year all the transactions of this Society be published in book form and delivered to the members.

This together with a small remuneration for the Secretary, would of course, necessitate considerable additional expense, certainly not less than $500.00. With a prospective revenue this year, of say $250.00, it is absolutely out of the question for the Society to undertake this work, and it would appear that something should be done towards obtaining an increased revenue. It has been suggested that the annual dues be increased. This, however, is a matter for the members to decide, and as according to the Constitution, no alteration can be made without at least one month's notice, and no such change can be made at this meeting. Your Council would suggest that this matter be given a very full and free discussion, so that some plan can be formulated now, to be acted upon at the next annual meeting. If some definite arrangements were concurred in by the majority of the members at this meeting, the incoming Council would be in a position to make their plans for the coming year."

## THE CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.

The Canadian Independent Telephone Association, which held its annual convention in Toronto, September 7th, 1909, decided that the growth of the independent telephone movement had reached a stage where the association should employ a paid Secretary. The time which the permanent Secretary should devote to the association's interests and his remuneration therefore were matters left to the Executive Committee to arrange. The convention chose Mr. F. Dagger, Toronto, formerly of Regina, for the Secretaryship, but it was understood that, pending a definite arrangement with Mr. Dagger, Mr. F. Page Wilson, Toronto, should continue to act as Secretary-Treasurer of the association.

The President, Dr. J. F. Demers, Levis, Quebec, was unable to attend the convention owing to illness. Dr. W. Doan, Harrietsville, Vice-President, presided. The delegates were welcomed to the city by Controller Hocken, in the absence of Mayor Oliver, and Mr. J. B. Ware, Chicago, General Secretary of the International Independent Telephone Association responded. The report of the Secretary-Treasurer, Mr. F. Page Wilson, stated that the number of rural companies had rapidly increased throughout Ontario. The number of independent telephones in use in Canada was placed at between 26,000 and 27,000. The formation of district associations was urged. Gratification was expressed that in the past year the Board of Railway Commissioners for Canada had decided that independent companies should be allowed to install telephones in railway stations.

The following resolutions were carried: That no member of the association should arrange any interchange of service over the lines of the Bell Telephone Company; that a committee should be appointed to watch legislation, and that efforts should be made to bring about Provincial Government ownership of all long-distance telephone lines.

Mr. F. Dagger read a paper, "Is the Telephone a Natural Monopoly?" He claimed that whereas monopoly had restricted the telephone service to the few, since competition had come the service had been cheapened and brought within the reach of thousands of people formerly unable to enjoy the benefits of telephones.

Officers were elected as follows:—President, Dr. W. Doan, Harrietsville; Vice-President, Mr. C. Skinner, Sherbrooke, Que.; Secretary-Treasurer (temporarily), Mr. F. Page Wilson, Toronto; Executive Committee, Messrs. F. Dagger, Toronto; Dr. Demers, Levis, Que.; G. W. Jones, Clark, Ont.; T. W. Ralph, North Augusta; A. Hoover, Green River; S. L. Squires, Waterford; M. House, Bridgeburg; Levi Moyer, Beamsville, and T. R. Mayberry, M.P.P., Ingersoll.

It was decided to meet again next year in this city on the second Wednesday of the Exhibition.

Below will be found a list of patents recently granted to Canadian inventors in Canada and United States, which is furnished by Messrs. Fetherstonhaugh & Co., Toronto.

### Canadian Patents.

E. A. Sullivan, Toronto, Ont., splice or angle bars; L. A. Batty, Toronto, Ont., hot air registers; A. R. Lacombe, Emard, Que., window construction; H. Carmichael, Victoria, B. C., means for rendering clay drain pipe waterproof; J. C. Fountain, Parkhill, Ont., methods and means for utilizing water in an artesian well to generate power; T. Latourelle, Montreal, Que., hot water heaters; F. H. Young, London, tanning machines; O. Baigne, Montreal, Que., windows; H. E. Pynter, Whitevale, Ont., plating device; R. J. Robillard, Ottawa, Ont., borner stays for boxes; J. Ruddick, Montreal, Que., automatic safety control devices or hydraulic elevators.

## COMPRESSED AIR ENGINEERING.*

By Frank Richards

The employment of compressed air as the agency of power transmission on some of the Barge Canal contracts, suggests inquiry as to the advantages and disadvantages of such transmission. Of course, in a way, contractors use their own experience and judgment, and select and determine their own means and methods, the only ultimate consideration being as to the perfect execution of the work and the complete satisfying of the specifications, but, still, if the means adopted find general approval from the start, the satisfying progress and the winning finish may be more confidently predicted.

The great engineering works of the ancients, and even those of the moderns up to a century ago, were executed, so far as we know, almost entirely by human hands using the primitive tools. To-day if the pick, the shovel and the wheelbarrow, backed by the main strength of the labourer, are ever permitted upon works of any extent, the fact calls at once for explanation or apology.

With the advent of machinery as modernly employed, steam was almost universally adopted as the source of power and, subject to the limitation of partially developed mechanical practice, it was applied as directly as possible to the machines to be operated or to the work to be done. For all outdoor engineerig work for the pumps, the hoists, the pile drivers, the excavators, the rock breakers, the means of haulage and what not, were all directly, and usually individually, steam driven, and apparently no one asked for, or indeed thought of, any radical change or improvement in motive power for such work or in the system of its distribution.

It has always been practically impossible, however, to use steam in mining, in tunnel driving or in subaqueous work of any kind, and practice in these lines developed and improved slowly in consequence. The rock drill it was which first demanded the air compressor, and the earlier builders of air compressors in large, commercial units found all their business provided for them by the rock drills, and quite naturally to-day the largest builders of air compressors are also the principal rock drill makers.

This initial and compulsory employment of compressed air for rock drills in mines and tunnels and similar work developed rapidly, compressors became numerous, and practical men began to appreciate the ready applicability of air to the various uses hitherto monopolized by steam. It happens that practically all the apparatus which is operated by air is similar to, if not identical with, that which is steam driven, and all steam driven machines can be driven, and generally better driven, by compressed air. Where a supply of compressed air has necessarily been provided for the strictly underground machines, and where there have been outdoor machines as part of the same general plant, it has often been a simple matter to pipe the air to the latter also, and thus to have the one power system cover the entire series of associated mechanisms. Wherever this has been done compressed air has shown itself not only permissable but extremely desirable and profitable, even for the additional items of employment not strictly compulsory.

As to the better drive of air than steam for the same machinery, that is easily demonstrable. Rock drills, whether to be operated by air or steam, are practically identical in design and construction, the only difference being usually in the style of stuffing box used. All drills are run for a considerable time at the factory, to get them broken in and running smoothly and satisfactorily before they are sent out. All the steam drills are first worked with air and after they work all right with that, then steam is used, and it invariably requires long and tedious coaxing before the drills can be made to run as freely and as lively with steam as they did with air. The first admission of the steam causes unequal heating and expansion of the closely fitted members, and also the condensed steam chokes the small and tortuous passages about the valves; also the lubricant which is used, when once it wets the surfaces of the air operated tool, remains a long time, while when steam is used in a drill for only a few minutes, so that it is thoroughly heated if the drill is taken apart and the surfaces supposed to have been lubricated examined, no trace of oil will be found in them, and they will usually be reported "as dry as a bone." The favorable experience with the rock drill, as to the use of air in preference to steam as the operating fluid, is repeated with all other styles of normally driven machines. The air operated machine is always and instantly ready and only the throttle requires to be manipulated or thought of.

In driving the tunnels of the Pennsylvania Railroad under the Hudson River at New York, it is not conceivable how the work could have been done without the constant aid of compressed air; but for the enormous excavation required for the passenger station of the same company, which was all outdoor work, the use of compressed air was not imperative, but still air was adopted for the work entirely upon its merits by men who knew, and the results have fully proved the wisdom of the choice.

The similar and even more extensive work of excavation for the new station of the New York Central in the heart of New York City, this also entirely outdoor work, is similarly being done entirely with compressed air as the power transmitter.

For engineering works of large extent and the completion of which will require months or years, so as to make the installation of a suitable plant worth while, compressed air is becoming more and more the favorite, where formerly only steam would have been thought of. Some of the largest stone quarries which have promise of permanence of output are now operated entirely from central air compressing plants. The compressed air installations on the Barge Canal at Crescent, at Vischer's Ferry and on the contracts in the western sections are fully warranted by successful engineering experience.

As has happened before in engineering matters and other things having to do with the world's progress, it has not been the scientific investigators, the official testers of efficiencies, those whose function it is to explain the why of things, who have been the leaders and promoters in this extension of general outdoor compressed air practice. For appreciation and opportunity compressed air is indebted almost entirely to the practical men who have been most closely in touch with it, and now the theorists can pat them on the back and patronizingly assure them that "they builded better than they knew." Perhaps so.

It is by no means difficult, after the practical man has established the practice, to find many cogent reasons which justify the extensive and permanent employment of compressed air. The general impression has been that, while compressed air has many things to recommend it in practice, it is still very wasteful of power, or that the amount of power ultimately realized at the extremities of the piping systems where the air is used is but a small fraction of that which is consumed in the initial compression of the air. The power losses in the use of compressed air have been harped upon until some persons have been able to think of nothing else in connection with it.

The truth is really in the other direction, when the use of air is compared with that of steam for the lines of work we are here considering. It is quite possible to show that the use of air compressed by steam at a central station, instead of using steam direct in the individual, widely distributed machines, effects a distinct saving at the coal pile and an enormous saving of operative labor in addition, besides securing the many accompanying minor advantages not generally enumerated and often not even thought of.

Of course it as an easy thing to cite cases showing how power is wasted by the employment of compressed air for power transmission. Some such occurred early in the compressed air experience of the writer himself. For nearly my first lesson, there was a straight-line, single-stage air

*From the Barge Canal Bulletin.

compressor running at normal speed and the entire air output of it was used to drive a steam pump down in a coal mine, the length of piping being not more than 1,000 feet, and the greatest efficiency I was able to figure out in the case, starting with the indicator card of the steam cylinder of the compressor, was 19 per cent. Of course, some of the loss here shown was chargeable to the pump itself, with its large clearance spaces to fill, and the use of the air entirely without expansion. Many cases where the too familiar steam pump is driven by compressed air would show results worse than this, while other types of apparatus so operated might show up somewhat better.

In another case I had a straight-line, single-stage compressor, with piping not exceeding 300 feet, to a small flywheel governor, slide-valve steam engine of suitable size. It was possible to adjust the work of the engine—the work was the driving of a fan—and the speed of the compressor so that the one would just supply the other, and each could be brought to a constant running speed. In this case the air passed through a heater by which its temperature was raised 150 degrees Fahr., and its volume correspondingly increased before it entered the engine. The best efficiency I could figure out in this case was 37 per cent.

All who have to do with compressed air can cite instances of power losses such as this, and they would seem to be conclusive against the use of the air, so far as power economy is concerned, were it not for the fact that a decidedly worse case can be made out against the use of steam. In the case where numerous machines are distributed over considerable areas, where the machines are all of them operated intermittently and with constantly varying loads, it is obviously impossible to make tests of power consumption for record or comparison. It is possible, however, to come to some agreement as to probable performance. A hoisting engine may be assumed to be as good an example as any of the machines to be driven. It will probably be fair to assume that the hoisting engine driven by air and working under fair ordinary conditions will, when actually working, realize 25 per cent. of the power consumed in compressing the air. That is, if a horse-power at the compressor costs 4 pounds of coal per horse-power hour, the coal cost at the hoisting engine will be 16 pounds per horse-power hour. One important thing in connection with each employment of compressed air is that it costs practically nothing except for the work actually done by it, and only while the work is being done. There are no heat losses and the losses by leakage, which we speak of later, are practically negligible. To cover all imaginable losses, however, we may concede an additional 5 per cent. thus allowing the net horse-power realized in work actually done by the compressed air machine to be only 20 per cent. of the initial horse-power at the steam driven compressor, and making the coal cost per horse-power hour, therefore, five times as great as at the compressor, or 20 pounds per horse-power hour.

As a matter of record it is quite possible to operate central compressor plants, with compound steam cylinders and condensers, and with boilers and boiler accessories designed and operated for economy, with less than three pounds of coal per horse-power hour. Then five times this, as above, would be only 15 pounds as the coal cost at the air driven machine.

When water can be utilized as the source of power, with or without the employment of electricity for transmission, the cost which then takes the place of the coal cost must be usually much less, or the water-power would not be employed, and this means that the cost which takes the place of the coal cost at the air driven machine is also less than it would be if steam was employed to drive the compressor, or it would be less than the equivalent of 15 pounds of coal per horse-power hour.

It is concededly impossible to generate steam at a central station and to transmit it by piping to the several machines to be operated, as we do transmit the air, on account of the constant heat radiation of the line and the consequent losses of condensation, besides the trouble caused by expansion and contraction of piping, water hammer, etc., the necessity of providing arrangements for trapping or disposing of the water of condensation, and, in spite of all precautions, the frequent stoppage for repairs entailed. Each steam operated machine, therefore, must have its own boiler and all appurtenances, its own supply of fuel and water. Such isolated and intermittently operated machines, taking the day through, cost in coal actually consumed at least 30 pounds, and often much more, per horse-power hour of work actually done, or about twice as much as the coal cost of the air operated machine.

With the air driven machine, when the air is piped to it, that end sit, and the operator has only to manipulate the throttle and attend to the lubrication. With the steam driven machine there is not only the cost of the coal actually consumed, but there is also the bringing of the coal to the machine, the supplying of the water, the firing and caring for the boiler, with all which that implies, so that there is for each machine the labor of a man, or at least the equivalent of one man's labor, to be added to the cost of operating.

The equivalent in coal cost of a man's labor is worth considerable. Say that coal costs at the machine $4 per short ton. Then if the man's wages is $2 per day, that will be 1,000 pounds of coal, or 100 pounds per hour, and for 10 horse-power, which is a big allowance for a hoisting engine, this would be 10 additional pounds of coal cost per horse-power hour.

So far, then, as the actual cost of the power used is concerned there is evidently a great saving in the employment of air instead of steam, and on this account alone it is no wonder that the knowing ones choose the air transmission, even that there are no special conditions, as in mining, tunnelling, subaqueous work, etc., compelling them to do so.

In addition to the saving in coal cost there are other advantages which air carries with it. In the use of steam there is the time taken to fire up and get the pressures before work commences, there is the warming up process and the working of the water out of the pipes and cylinders every time the machine is started up after standing, none of which delays occur with the air, so that in constant readiness and instant realization of power to the utmost limit required, the air will every day put in from 10 to 25 per cent. more actual work per day. Stuffing boxes will give no trouble; water will not knock out cylinder heads; pipe joints will not be giving out, there will be no chance of low water in the boiler, no burning of flues or crown sheet, no possible blow up. The cost and repairs of maintenance will be much less and the certainty of continuous readiness for work will be much greater. While, as was said, the air-driven machines are identical with the steam-driven type, the individual boilers and their appurtenances are dispensed with, the cost of them, as far as it goes, helping to offset the larger cost of the compressed air installation as a whole. The saving in repairs and maintenance, with the reduction in the cost of the air operated machines by dispensing with their boilers, may go to offset the fixed charges entailed in the larger cost of the compressors and piping.

The installation and operation of a complete, economical and reliable compressed air plant calls for no extraordinary reach of knowledge or skill, but it does demand thorough and conscientious engineering. The things which are worth while and which will guarantee satisfactory results are to be insisted upon. Excellent apparatus is provided by the makers of that class of machinery, if demanded. In mechanical lines there are no more creditable records than those of modern air compressors employed in the larger and more responsible engineering works.

In driving the tunnels under the North and East Rivers, at New York, the compressors ran without interruption, maintaining constant air volume and pressure for months, the lives of men dependent upon their continuance, and they never failed. If good machines are selected, and they are properly installed and connected, there will be no cause for complaint or disappointment. The earlier employments of

compressed air were more or less of a temporary or experimental character and many things were permitted which long discredited compressed air practice. There is no excuse for this to-day.

The steam engine element of the steam driven compressor is in no essential different from the stationary steam engine, and it has the advantage of a practically constant load per stroke, so that the relative and actual sizes and capacities of cylinders may be selected with close adaptation to the work to be done. The details which secure accuracy of working are sufficiently familiar.

High pressure steam, with or without the refinement of super-heating, compound cylinders and condenser, are the essentials, not all of which can be always insisted on; then the compression of the air should be two-stage with efficient intercooling and aftercooling.

With respectable compressors secured and installed, the valves and connections and piping should correspond. There is no excuse for leakage and there should be no opportunity to talk about it. Steam has the advantage that it can tell of its leaks and insist upon their avoidance, so when first-class steam piping is required it can be laid and connected so that there can be given an almost positive guarantee that there shall be no leak when the steam is turned on, and if a leak is revealed it is more or less a reproach to the workman or the supervising engineer.

If piping can be laid perfectly tight for steam, it can be laid as tight and reliable for air, for what will suffice for the one will be quite as satisfactory for the other. In fact, as the air pipes are not heated and cooled and expanded and contracted as steam pipes are, it is easier to make them tight and to keep them so, and this is practically demonstrated and enforced by the excellent piping throughout the installations at Crescent and at Vischer's Ferry, where those in charge assured the writer that the leakage losses were inappreciable. Where rock drills are driven by air with hose connections, some leakage may occur, but even here it is almost entirely preventable. There is a certain quarry of large extent in Ohio which is operated entirely by compressed air from a central plant and which is so perfectly piped and so carefully looked after, that when the compressors are stopped, the pressure is maintained in the pipes all night

To an engineer familiar with the running of hoisting engines and the usual types of machines employed for outdoor service and driven by steam from the boiler to which it is tied, the use of air for the same purpose comes as a pleasant experience. The instant readiness of the air and the lively movement of the machine at once is so different and such a relief from the sluggish action of the steam. There is no waiting for the cylinders to heat up and no watching of pet-cocks to save the cylinders. The hand or the bare arm can come in contact with any part without fear of burning.

This is the universal experience in the use of compressed air for power. There is, however, one familiar accompaniment of inconvenience—the accumulation of moisture in the air pipes and the choking and freezing up of the exhaust pipes in consequence. This is, of course, an objectionable feature and at first it might be urged as even without remedy but later practice has minimized, if not abolished, this trouble.

There is no way of securing dry, free air to begin with. All air contains a considerable percentage of moisture, so that after the air is compressed into much smaller volume it is then saturated, and more than saturated, with moisture, so that water begins to be dropped in the pipes as it flows along and ultimately may make trouble in the drill or engine where the air is used. The simple remedy is to allow the air to deposit its moisture and then draw the water off, before it comes to the machine.

When the air is at its highest pressure and its lowest temperature, its saturation point, or its capacity for carrying moisture, we might say, as a part of itself, is at the lowest, and then, if it has the opportunity, it will give up so much of the moisture that what remains will not be heard of. It is almost the universal custom, when a compressor is installed, to place an air receiver close to it, and all the air compressed first passes through this receiver. The receiver is provided with a drain cock and the engineer is instructed to occasionally open this and draw off the water. But really very little water is ever found here. Some oil and dirt, originally inpalpable dust in the air, will accumulate, and this it is proper to get rid of, but the air has not got ready to release and deposit the moisture, because as it passes through this receiver, it is still hot with the heat of compression. When the air passes through pipes of sufficient length to thoroughly cool it, if there is then provided another receiver or other opportunity for depositing the moisture, with means for drawing it off, always remembering that water runs down hill, then the air will be sufficiently dried for use without annoyance.

Outside the compressor house at Crescent there is a large horizontal receiver with valves and piping for distributing the air in the different directions required. Here, as usual, there is a drain cock, but little or no water can be drawn from it. One air line from this compressor runs more than a quarter of a mile to two three-drum hoisting engines used for loading crushed stone upon boats in the Erie Canal. It happens that it is sometimes desired to run these hoists when the compressor is not in operation, and so a steam boiler has been placed in position with all the necessary connections. When the air is in use this boiler becomes an air receiver, the air passing into it and then through the connecting pipes to the hoists, the same pipes and valves being used for either the air or the steam. As the air comes to this boiler, or receiver, cooled by its journey through the pipes, it is here in position to deposit its moisture, and here the water is found, and the hoisting engines are then run without trouble.

The better way, after all, is to drain the air as completely as possible immediately after the compression. A fine example of advanced modern practice is offered in the compressed air plants for the Rondout siphon of the Catskill water-supply for New York city. Here there is an immense job of shaft-sinking and tunneling, the compressors to be used being 10 Ingersoll-Rand Imperial Type X Corliss, compound condensing steam, and two-stage air, the air pressure being maintained at 110 pounds. There are here, as usual, air receivers near the compressors, one large receiver for each pair of compressors, but directly connecting with each receiver is a large intercooler, through which the air must pass and be cooled to normal temperature before entering the receiver. This provides the conditions of highest pressure and lowest temperature for the air, so that it cannot fail here to drop superfluous water, which, therefore, can cause no further trouble when the air is finally used.

## TOLL OF THE RAILWAYS.

### Accidents in August.

Thirty-two persons were killed and fifteen were injured by the steam railways of Canada during August. On the electric roads 27 were injured and three killed. Many of the accidents, due to trespassing, are avoidable. Most of the fatalities were due to carelessness and neglect. It is an unenviable record. But, when compared with July, the figures for August are more desirable, and it is obvious that more care is being exercised by those connected with the operation of trains. Exclusive of trespassers and persons crossing the tracks at grade, only ten people were killed during the month. Which proves conclusively that the majority of the accidents are preventable.

Statistics issued by the Board of Trade show that not a single passenger in the United Kingdom lost his life in a train wreck during the year 1908, though many persons were killed by railway trains in various other ways, such as crossing the tracks, trespassing. This is a notable record. It has been made possible by the fact that the roadbeds are maintained in the highest condition of excellence, that all

the important railroads are double-tracked and that the tracks are kept comparatively free from trespassers. There is also the important fact that human life is not held so cheaply in the Old Country as it is in the United States, and, we regret to add, in Canada.

The totals for July and August compare as follows:

| | Passengers. | | Employees. | | Others. | | Totals. | |
|---|---|---|---|---|---|---|---|---|
| 1909 | Killed | Injured | K. | I. | K. | I. | K. | I. |
| July ..... | 3 | 12 | 26 | 12 | 22 | 7 | 51 | 31 |
| August ..... | 4 | 5 | 6 | 8 | 22 | 2 | 32 | 15 |
| Decrease .... | | 7 | 20 | 4 | 0 | 5 | 19 | 16 |

Here is the record of the electric railways:

| | Killed. | Injured. |
|---|---|---|
| Run Over ..... | 2 | 2 |
| Falling Off ..... | 1 | 6 |
| Struck by car ..... | — | 6 |
| Derailment ..... | — | 12 |
| Collision with fire engine ..... | — | 1 |
| Total ..... | 3 | 27 |

A gratifying decrease in the number of employees killed during August is worthy of note. But there is still room for improvement.

| Character of Accident. | Passengers. Killed | Injured | Employees. K. | I. | Others. K. | I. | Total. K. | I. |
|---|---|---|---|---|---|---|---|---|
| Derailment ..... | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Head on Collision ... | 1 | 3 | 1 | 1 | .. | .. | 2 | 4 |
| While Shunting ..... | .. | .. | 1 | 3 | .. | .. | 1 | 3 |
| Highway Crossing .. | .. | .. | .. | .. | 8 | 1 | 8 | 1 |
| Fell off Freight Cars. | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Trespassing ..... | .. | .. | .. | .. | 14 | 1 | 14 | 1 |
| Pitch in with hand car | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Adjusting Couplings. | .. | .. | 1 | 2 | .. | .. | 1 | 2 |
| Passengers falling off | 2 | .. | .. | .. | .. | .. | 2 | .. |
| Working on track ... | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Attempt to board moving train ..... | 1 | 1 | .. | .. | .. | .. | 1 | 1 |
| Falling off hand car. | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Unclassified ..... | .. | 1 | .. | .. | .. | .. | .. | 1 |

Railway wrecks are expensive. They invariably result in serious damage to the rolling stock or the track, not to mention loss of life and terrible injury. A Great Northern locomotive which plunged through a burning bridge on June 19, and dropped forty feet into the Fraser River, near New Westminster, resulting in the loss of two lives, was recovered on the 23rd August. Repairs which are necessary will cost thousands of dollars. This is only one instance of costly mishaps which might be avoided if more caution were used.

Some notes regarding wrecks in which much damage was done to rolling stock and other railway property follow:

Near New Glasgow, N. S., an I.C.R. freight train was ditched, causing much damage to rolling stock, and considerable delay.

Near Sunnyside, Toronto, three coal cars were derailed and many ties torn up, resulting in six hours delay to the C.P.R. Coldwater express.

A C.N.R. freight was ditched at Matawawan, near Port Arthur, blocking the road for many hours.

At the Caledon Horse Shoe Curve, a C.P.R. passenger train left the rails, causing some hours' delay.

West of Ingolf, Ont., a C.P.R. work-train of 8 cars was derailed, damaging the track and blocking the line for 8 hours.

Four hours delay and considerable damage to the track and rolling stock was the result of a break in the axle of a G.T.R. tender near Waubaushene.

A G.T.R. passenger train ran into an open switch near West Toronto. The engine and several cars were derailed.

A broken axle caused the derailment of a car on a C.P.R. passenger train. The track was slightly damaged and the train delayed six hours.

The C. P. R. Atlantic express was ditched at Woman River, causing serious damage to rolling stock and 5 hours' delay.

Near Young's Cove, N.B., a freight train of the N.B. Coal and Railway Co., was derailed, resulting in several hours delay.

## LONDON PUMPING PLANT.

Messrs. Vandeleur and Nichols of Toronto have been awarded the contract for the supply and installation of the complete apparatus required for the new London, Ontario, Domestic Pumping Service. It will be remembered that a short while ago the Honorable Adam Beck, on behalf of the citizens of London investigated the conditions affecting their water supply and came to the conclusion that there was room for improvement. The rate payers approved of Mr. Beck's suggestions and empowered him to complete such arrangements as he had deemed advisable. In consequence, Mr. Beck secured control of a considerable quantity of land on which he has sunk the shafts for fifteen artesian wells. The water from these wells is to be lifted by means of compressed air. It will flow by gravitation into a central located reservoir and from there it will be drawn by powerful triplex plunger pumps. There are some unique features about the installation which will bear nothing. The total capacity of the plant is stated on the air compressor side to be of 1500 cubic feet per minute, and on the pump side, of four and one half million gallons per day. There are three air compressor units and three pump units. Two of each of these machines are to be motor driven, the power being obtained from the Hydro-Electric power distribution system, the third unit being operated by a gas engine. The air compressor units comprise Reavell's single stage, quadruplex, water jacketed compressors, directly connected by flange coupling to a slow speed alternating current, 3 phase, 25 cycle motor of 82 B.H.P. capacity. In the gas engine driven air compressor unit the two machines are united by a disc coupling, the gas engine in this case being of 90 B.H.P. The reason the gas-engine-driven units are installed, having one half capacity of both motor driven sets, is that occasion might arise whereby the electric supply would be interrupted, and it is as an insurance against a prolonged shut-down that such a provision has been made. The two motor driven pumps are gear connected, the gear in each case being enclosed in an oil bath. This is to reduce the noise. The gears are composed of the new unica product, which is nothing more than compressed cotton. The motors in this case are of 120 B.H.P. capacity and will operate at 720 r.p.m. The gas engine driven pump consists of the pump and a 150 B.H.P. gas engine. This is a direct drive, flexible coupling uniting the two. This pump is so arranged that the gas engine can readily be thrown out of commission and a motor at the other end of the pump shaft quickly connected through gearing and clutch and three pumps operated together, thereby increasing the pressure in the mains in the event of conflagration. The pumps and gas engines are manufactured by Messrs. T. H. & J. Daniels of Stroud, Glos., and the pumps are fitted with the famous 'Guttermuth' valves which permit of operation at a comparatively high speed, namely, 170 r.p.m. The compressors also operate at a comparatively high speed, namely, 235 r.p.m. Special arrangements have been made to make the plant as automatic as possible and it is anticipated that for its size this pumping station will require less atendance than any other similar plant. Notwithstanding the fact that the capacity of these units is large, the space they will occupy is only 26′ x 80′ which includes provision for office and wash rooms, etc. Mr. H. J. Glaubitz, C.E., is consulting engineer for this scheme.

The question of forestry laws in Sydney, N.S.W., is shortly to be taken up by the Hon. C. G. Wade, K.C., prime minister. Provision will be made for classification of the timber lands of the state, for the dedicating of areas as permanent forests, for afforestation, and generally for regulating the timber trade in such a way as to safeguard the public interest and preserve the rights of those engaged in the industry. The lumber wealth of New South Wales is almost incalculable, and hardwood and cedar trees abound.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Aug. 31 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Aug. 27 '08 | Price Aug 20 '09 | Price Aug. 27 '09 | Sales Week End'd Aug27 | Price Aug 27 '08 | Price Aug. 20 09 | Price Aug. 27 '09 | Sales Week End'd Aug27 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,384 000 | 2,008.000 | 177 | ..... | 184¼ | 350 | 176¾ | 176½ | 186 | 185 | 930 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 253.600 | 242,900 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 1,321,529 | 1.112.000 | ..... | ... *1st. pref. 107½, 3rd pref. 58¾, ordinary 24¾ | | | ..... | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | 52,342 | 25,844 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 80,013 | 71,335 | ..... | ..... | ..... | ..... | 180 | 178½ | 213 | 212½ | 30 |
| Toronto Street Railway | 114 | 8,000 | 100 | 77,434 | 68,556 | ..... | ..... | 124½ 123 | 88 | 165½ | 165 | 124¾ | 124 | 229 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 167 165½ | ..... | 190 187 | 2 | ..... | ..... | ..... | 186 | ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILWAY EARNINGS FOR AUGUST.

Substantial increases in the earnings of the Canadian railways continue. The accompanying table, which gives the figures relating to the month of August, together with statistics from January 1st to August 31st, compared with the records for 1908, is probably one of the best indications of Canada's march of progress.

C.P.R. gross earnings in August broke all previous records for that month. The earnings were $7,152,000, as compared with $6,254,000 for the same month last year, an increase of $898,000. The gross for the month also showed a considerable increase over the figures for 1907, when the takings of the road for the month reached a record of $6,900,000, showing an increase for the present month of $252,000 over the best previous August in the company's history.

For the last week of August the earnings of the road were very near to making a record, being exceeded only by two or three similar periods in the history of the C.P.R. For the "week" of ten days, ending August 31, the gross earnings of the system were $2,384,000, as against $2,008,000 last year, and $2,243,000 in 1907, showing a handsome increase over both.

With remarkably few exceptions the returns for August this year show good increases over those for July, as will be observed from the following table:

| | Aug. 1909 | July 1909 | Increase or Decrease |
|---|---|---|---|
| C. P. R. | $7,152,000 | $7,004,000 | + $148,000 |
| C. N. R. | 807,100 | 843,500 | — 36,400 |
| G. T. R. | 3,789,948 | 3,491,184 | + 298,764 |
| T. & N. O. | 147,983 | 136,627 | 11,356 |
| Montreal Street | 312,678 | 300,968 | + 11,710 |
| Toronto Street | 300,887 | 292,589 | + 8,298 |
| London Street | 21,806 | 23,692 | — 1,886 |

The August 1909 earnings of the large steam roads have only been exceeded during one or two of the big October week's in previous years, when the East and West traffic was at its height. The past few weeks show returns which beat all records in this country for the carrying of passengers, and this is what is causing the remarkably high earnings. While freight traffic is also good, it is not approaching the figures which will be reached later on, when the Western wheat starts moving heavily, with its resultant westbound traffic. But the passenger traffic at the present time has reached its zenith.

| Company | Month of Aug. 1909 | Month of Aug. 1908 | Increase | Jan. 1 to Aug. 31, 1909 | Jan. 1 to Aug. 31, 1908 | Increase |
|---|---|---|---|---|---|---|
| Canadian Pacific Railway | $7,152,000 | $6,234,000 | $918,000 | $49,124,860 | $42,464,000 | $6,660,860 |
| Grand Trunk Railway | 3,789,948 | 3,573,244 | 216,704 | 25,521,076 | 24,628,954 | 892,122 |
| Canadian Northern Railway | 807,100 | 747,400 | 59,700 | 5,694,460 | 5,188,400 | 506,060 |
| T. & N. O. | 147,983 | 80,440 | 67,543 | 929,639 | 516,282 | 413.357 |
| Montreal Street | 312,678 | 286,715 | 25,963 | 2,334,438 | 2,204,336 | 130,102 |
| Toronto Street | 300,887 | 276,132 | 24,755 | 2,349.955 | 2,167,179 | 182,776 |
| London Street | 21,806 | 25,228 | *3,422 | 154,464 | 151,788 | 2,676 |

* Decrease

## RAILROAD EARNINGS.

All railroads reporting weekly have now reported for the three weeks of August, and the total gross earnings are $21,541,714, an increase of 10.8 per cent. over last year, and a loss of only 2.6 per cent. as compared with a like period in 1907. Large gains continue to be reported over last year and several roads show increases as compared with the very active year 1907. In the following table is given earnings of United States roads reporting for the three weeks of August and same roads for a like period in July and June:

| | Gross Earnings 1909 | Gain | Per Cent. |
|---|---|---|---|
| August—three weeks | $21,541,714 | $2,101,115 | 10.8 |
| July—three weeks | 19,909,497 | 979,028 | 5.2 |
| June—three weeks | 19,875,232 | 1,749,658 | 9.7 |

A number of United States roads have now reported for July, and total gross earnings are $98,311,912, an increase of 10.6 per cent. over last year and a loss of 7.0 as compared with July 1907. Good gains are reported by all classes of roads, which are very heavy on the Eastern Trunk lines. Pacific systems and other Eastern roads. The Granger roads also report a large gain over last year, and a gain of nearly 6 per cent. over July 1907. The statement is printed below:—

| July | Gross Earnings 1909 | Gain | Per Cent. |
|---|---|---|---|
| Trunk Eastern | $19,866,634 | $ 2,762,467 | 16.8 |
| Trunk Western | 8,146,393 | 520,398 | 6.9 |
| Coal | 3,092.399 | 174,928 | 6.0 |
| Other Eastern | 3,383.503 | 346,291 | 11.4 |
| Central Western | 6,254,183 | 284,985 | 4.8 |
| Granger | 14,151,534 | 1,681,956 | 13.5 |
| Southern | 15,905,767 | 878,028 | 5.8 |
| South-Western | 22,366,524 | 2,046,206 | 10.1 |
| Pacific | 5,144,075 | 694,482 | 15.6 |
| United States Roads | $98,311,912 | $ 9,389,662 | 10.6 |
| Canadian | 7,004,000 | 808,000 | 13.1 |
| Mexican | 4,442,621 | 209,588 | 5.1 |
| Total | $109,738,533 | $10,407,250 | 10.5 |

Dun's Review.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## WATER SUPPLY AND PURIFICATION.*

By T. Aird Murray, C.E., of Toronto.**

The general question of water supply is an extremely wide one. The question of purification is no less wide. It would be impossible for me to do justice to the subject within the limits of a single paper. If I attempted to deal with the various headings into which the subject may be divided, such as Available Rainfall and other sources of supply, (such as direct collection of rainfall, springs, wells, streams, rivers, lakes, and storage reservoirs, and the different values to be attached to shallow wells as against deep wells, the various methods of water purification by means of chemical re-agents, slow or rapid sand filtration, sterilization, etc.), I feel sure that such a dessertation would only weary you, and my observations would be so incomplete that no definite data could be conveyed.

I have, therefore, as it were, mentally reviewed the whole subject with a view to selecting one or two particular phases of the problem of water supply which I consider are more particularly of practical value as effecting general economy and efficiency. The subjects which I have selected are:—"Tuberculation and growths in water mains, their prevention and removal," and "Purification of Water by Mechanical Filtration." Even to treat these two subjects conclusively would present a gigantic task; no one expects, however, that more than the salient features can be touched upon in a short paper.

### Tuberculation and Growths.

These may be divided as follows:—(a) Rust, tuberculation, rust nodules. (b) Incrustation due to alkalinity. (c) Biological formations due to organisms. (d) Sedimentary deposits. All of the above either separately or together frequently occur in water mains. They are the cause (apart from extended distribution) of the gradual diminution pressure so common in our water systems. They are the further cause of the gradual and sometimes enormous increase in power required to maintain necessary pressures.

Mr. Desmond Fitzgéralds' (Transactions of the A.S. C.E. Vol. 15, p. 337, 1886), states:—"Great attention is paid by hydraulic engineers to the designing of dams, aqueducts, reservoirs, etc., structures connected with the source of water supply; but the question may well be asked:—Is proper attention paid to the pipe or distribution system? Experiments and formulae we certainly have of the flow of water through pipes, but the writer is inclined to believe, as the result of observations, that when the water has once been turned into a pipe system, little more attention is paid to the condition of the pipes. Sometimes, it is true, small pipes fill up entirely, and then specimens are exhibited showing the growth of tuberculation. Again the water becomes bad in one street whilst it is good in the adjoining neighborhood, and the result is attributed to some mysterious agency. It is believed by the writer that one of the great steps in advance that will be made in years to come in the designing of pipe systems will be the introduction of facilities for cleaning out the pipes at stated intervals of time. This will be found necessary, not so much for restoring the normal capacity of the pipes as for maintaining the purity of the water." The above statement was true twenty years ago when it was made, it is equally true to-day. Numbers of water systems can be pointed to, where the water as delivered at the tap is more impure than the water at the source, and where it becomes year by year more difficult and expensive to maintain satisfactory pressure owing to the reduction of the diameter of the pipes.

Although much attention has been given to the subject of growths in water mains and their removal in Great Britain, comparatively little has been given in this continent. Where attention has been given, however, the results have provided the utmost satisfaction, both from an economical and efficiency point of view. Electric engineers are careful to provide inspection boxes on their transmission lines, and even sewers are provided with manholes which allow of inspection; but as a rule no means are provided for the general inspection of the condition of water mains, or facilities provided for cleaning out even the dirt which will accumulate apart from the removal of rust and other growths.

Before going into the question of the removal of tuberculation and growths it may be well to shortly review what knowledge we have of these incrustations.

Tuberculation is the term applied to rust or oxide of iron which forms on water mains, principally in such mains where pipes have not been originally properly protected with some coating mixture. Small pipes may become completely choked with rust. With large pipes, however, there appears to be a limit to the thickness of rust, an inch and a half of incrustation provides a protection to the body of metal forming the pipe. Rust incrustation in pipes, commences as a rule as small specks, appearing at points where the protective coating leaves the pipes exposed. The specks grow rapidly in the form of nodules like limpets, gradually covering the whole internal surface and eating under the protective coating which they scale off and destroy. These limpet-shaped cones, or rust tubercles, as they are called, are generally hard on the surface and soft inside, and are easily removed by scraping. The rust is the result of a combination of the iron and the air which is always present in water; it occurs equally with filtered or unfiltered waters, and grows at greater rapidity with soft waters than with hard. In fact under certain hard waters rust tuberculation is practically unknown, even with uncoated pipes. The tendency to rust growth with soft water is due not to the degree of softness or hardness, but due to the fact that most soft waters are of surface origin and contain vegetable acids, such as carbonic acid due to organic fermentation. One thing is certain, and that is that no tuberculation will occur where the internal lining of the pipes is properly protected. Rust tuberculation means the gradual diminution of the pipe thickness, and consequent weakening.

There are, however, other incrustations which are not dependent upon the amount of protection to the pipe surface, such may be due to alkalinity. Hard water is caused principally by the presence of salts of magnesium and calcium. The carbonates and bicarbonates of these salts producing temporary hardness. Permanent hardness on the other hand is produced by the sulphates, chlorides and nitrites of these salts. In the case of the salts producing permanent hardness, we have the incrustations found in boilers due to evaporation of the water leaving the salts behind, these do not affect the distributing mains. In the case of the salts

*Paper read before the Convention of the Municipalities of the Province of Saskatchewan at Regina, September.

**Consulting Sanitary Engineer to the Saskatchewan Government.

producing temporary hardness, however, we find that the carbonates are soluble in the presence of carbonic acid, and form incrustations of crystallized scale of calcium carbonate. This scale is found in large quantities in some places, depending upon the quantity of bicarbonate of lime and carbonic acid in the water. The usual method of removing temporary hardness is to add milk of lime according to "Clarke's" process for softening water.

Biological formations due to organisms are frequently found as growths in water mains and concrete or brick conduits, they exist as "Sponge," "Pipe moss," "Ferruginous slime," etc. These as well as curtailing the diameter of the pipes and reducing pressure, are the cause of unpalatable conditions, and even of foul odors from the water. The most serious of these growths is that known as "ferruginous slime," which is the product of certain iron organisms known as the "Grenthrix" group. The deposit is generally black, or red, or of a dirty yellow, or brown color; and flocculent masses may often be seen floating, which have become disengaged from the pipes. The writer has seen this deposit lining a water main to over an inch in thickness. The iron which is contained in the slime is not due to the pipes, but is entirely due to iron in the water, and has nothing to do with the question of rust formation; as it may form in brick or concrete conduits, as stated above. It just as readily forms in coated pipes as uncoated, and it is for this reason that many do not consider it necessary to use coated pipes, confusing this organic iron growth with rust. The writer has had occasion to make several observations and experiments in connection with this particular growth, and concludes that it is due to a combination of iron in solution and organic impurities in the water. The growth is more common in connection with ground waters, and in his continent has made itself evident at Jamestown, N.Y., Brooklin, Waltertown, and other places in Massachusetts. It is also very common in the surface waters of English towns, especially in the waters from the Penine Range of hills. I regret that I have not yet had an opportunity of studying the waters of this province, in order to make a systematic examination as to their relation to the particular growths with which I am dealing. This, however, is something for the future, and I have no doubt, that many of you are practically acquainted with many of the growths noted.

Sponge or Spongidae is the chief cause of many waters becoming foul in autumn time. It dies during the autumn, and in the process of decay imparts an unpalatable taste and odor to the water. It is really a fresh water sponge. They are usually found on the tops and sides of pipes. They only occur in connection with surface waters, more especially in the case of lake water.

Pipe moss forms an extremely common growth in water mains, and may take the form of matting covering large areas to considerable thickness. It is very permanent and is not usually found floating, as may be the case with the iron slime and sponge. It has all the appearance of moss and may take the form of branching filaments.

Sedimentary deposits are too well known, and require little explanation. Such are common when the water is obtained from rivers or turbid sources. Mud, sand and clay are their chief constituents.

The above incrustations may be again summarized along with remedies required for their prevention or removal.

| | | |
|---|---|---|
| Rust tuberculation or rust nodules | Well coated pipes | Scraping the mains. |
| Incrustation due to alkalinity | Treatment with milk of lime. (Clarke's process). | Scraping the mains. |
| Biological growth. | Filtration. | Scraping the mains. |
| Sedimentary deposits. | Sedimentation in basins with or without coagulants | Flushing and scraping the mains. |

Now, even after taking all the preventive measures necessary with many waters, it will be found that mains will still have a tendency towards incrustation. The question, therefore, arises as to whether money would be well spent in the first instance in providing sufficient means of control over a water system to allow any length of main to be readily cleaned out at any time. The usual method of providing control is by means of hatch boxes placed at intervals on the lengths of mains; these allow of an opening to the main being made without cutting into it and breaking into the roadway. Scraping machines, of which there are many in the market, are simply cutting tools which are forced through the pipes by the pressure of the water, and have the effect of increasing the pipe diameter to the original bore. The following list shows the percentage of pressures gained at various places in England immediately after scraping the mains.

| | % | Main. |
|---|---|---|
| Owestry | 54 | 6" |
| Lancaster | 56 | 8" |
| Bradford | 55 | 18" |
| Whitelawn | 28 | 12" |
| Waterford | 40 | 13" |
| Cuper Fife | 52 | 7" |
| Merthyr Tydfil | 30 | 14" |
| " " | 82 | 12" |
| Omagh | 300 | 6" |
| Lanark | 34 | 7" |
| Bridge of Allen | 35 | 6" |
| Thurso | 7 | 6" |
| Cowdenheath | 23 | 6" |
| Burntisland | 43 | 8" |
| Torquay | 28 | 10" |
| Aberdeen | 107 | 4" |

At Halifax, N. S., Canada, the effect of removing incrustation was most marked. The mains there are scraped out yearly. The first operation occurring in 1880 brought about 34.2 lbs. sq. in., pressure at 25 hydrants at which the nozzles previously showed no signs of water. In 1881 the same hydrants showed 43.5 lbs., sq. in., and in 1882 52.4 lbs. sq. in. The engineer reported that the mains were all heavily tuberculated in some instances the incrustation being 1-½ in. thick. Similar experience was gained at St. Johns, at Boston Mass. Scraping the pipes just more than doubled the supply of water. It is quite practical to remove the whole of rust or other growths from mains without injuring the original coating of the pipes.

Mr. N. S. Hill before the American Water Works Association has recently given some interesting figures upon the cost of scraping water mains. He takes for example a 6-in. main to cost $1.00 per foot, and to require replacing with another main of the same size in 20 years, owing to the increased consumption and the effects of tubercular deposits. Assuming money to be worth 4 per cent. per annum, then the cost of a new main at $1.00 per foot, 20 years hence, would be equivalent to 46 cents at the present time. Assuming that by proper inspection and cleaning the construction of the additional main could be delayed 10 years, the cost of a new main 30 years hence would be equivalent to 30 cents at the present time, viz: 46-30 = 16c. per foot would thus be saved, which at 4 per cent. equals 64 cents per foot per year, add to this the saving in interest on $1.00 per foot for 10 years = 4 cents per foot per annum and we have (6.4 x 20 or 12.8) + (4 x 10 or 40) = 52.8 cents per ft. of 6 in. main as the amount, we should be justified in spending in maintenance during 30 years, in addition to present cost in repairs, which we assume to be the same, and which averages about 17 cents per foot per year for all sizes of mains. In other words we would be justified in spending just 10 times as much for maintenance as we do at present even if all the pipes were only 6 inches. If the periods are reduced to 10 and 20 years respectively, which is more probable with heavy incrustations, then the justifiable expenditure for maintenance would be 48.4 cents per foot for 20 years, and 2.42 cents per foot per annum, which would be sufficient to clean the mains every five years.

A great deal more could be said on this subject from the economic point of view in connection with pumping and forcing water through incrusted mains. Atlantic City suffered for many years as a result of tubercular growths in the water mains. As a result of cleaning out the mains the pumping efficiency was increased as follows: Before cleaning, the 18,000,000 gallon pump, which delivers the water into the reservoir was put under a pressure of 110 pounds, and made 11 revolutions per minute, delivering 11,888,000 gallons. After cleaning under the same pressure it made 16-½ revolutions per minute, delivering 17,820,000 gallons, showing an increase in delivering capacity of 5,400,000 gallons in 24 hours, or 45.4 per cent. This enabled the department to fill the reservoir, and saved a contemplated expense of laying an additional main 30 in. (18,000 feet) at that time. Also, the amount saved in fuel required before and after the pipes were cleaned worked out at about 36 per cent.

Now supposing that a municipality contemplated putting down a water system with ample provision for control by means of hatch boxes, so that the system might be examined and scraped at any time without disturbing roads or cutting into the mains. What would be the cost? It is estimated for a population of 50,000 with 92 miles of main averaging 12 inches in diameter, the cost of distribution system amounting to $1.80 per foot of main, consumption at 60 gallons per head per day, that the cost for an ample supply of batch boxes would add 15 cents per foot of main, or 8.3 per cent. increase to distribution system. If the supply be one of pumping, the increase on the total cost of plant amounts to about 4.7 per cent.

Experts on this question, and in fact all who have had experience in this matter, are agreed that the actual cost incurred by the installation of hatch boxes, intelligently spaced out, is more than balanced by the benefits obtained.

I have also promised to make a few remarks on the question of mechanical filtration as applied to water supplies.

There is a rapidly growing opinion that all surface collected waters, especially those drawn from rivers, should undergo some purification process before being delivered for consumption; apart from the direct discharge of sewage into water courses there are many other sources of contamination. We have seen that many of the biological growths occurring in water mains are directly due to organic impurities in surface water. The removal of these impurities ensures longer life to the mains, more constant pressures, and a water free from mal-odours, bad tastes, and less contained nutriment on which pathogenic bacteria can be maintained.

Water purification may be effected by (a) filtration (b) direct sterilisation.

Filtration may be divided into two processes. 1st, slow sand filtration, and 2nd, rapid mechanical filtration.

Slow sand filtration necessitates large areas of filter beds, and very fine grained sand is used. The purifying powers of these filters is primarily due to the formation of a sediment blanket on the surface of the filter. At first very little bacterial purification results, but as the sediment scum forms, the percentage removal increases up to very high rate efficiencies, gradually as the scum or blanket thickens, the rate of filtration is lowered until it is necessary to remove the scum by scraping, until the scum blanket forms the water passing through the filter is passed to waste. The filter beds are naturally about 1 acre in area, the rate of filtration being about 2,000,000 gallons per acre per day. This system has been adopted largely in Europe in connection with river waters. Its introduction has invariably been followed by a marked reduction in the typhoid fever rate. Several cities in the American States have also adopted the system. Toronto in Canada is at present putting down a large plant to treat 30,000,000 gallons per day. The system as compared with others is very expensive both in first charges and in maintenance, and it is doubtful whether it would be possible to work it under the severe frost conditions of this province.

Mechanical or rapid filtration occupies much smaller areas. The sand used is coarser than in the case of slow sand filtration. The rate of filtration is about 120,000,000 gallons per acre per day, or 60 times the rate of slow sand filtration. With municipal plants, the size of a single filter is equal to about a hundreth part of an acre. Very high purification efficiencies are obtained by this method. Efficiency depends not so much upon the filter, however, as upon the use of a coagulant and general attention and care to proper working. At Harrisburg, Pa., the average bacterial removal for the year 1908 was 99.62 per cent. Similiar high efficiencies are obtained elsewhere. The filter is constructed more with a view to obtaining an efficient sand washing apparatus, while purification is obtained by the proper use of a coagulant, combined of course with the filter action.

This system is peculiarly adapted for our Province, as the whole plant can be housed in a small building and thereby worked independently of severe frost. Its power of removing turbidity is very great, and we are all well aware how turbid our rivers are in the early months of the year. I saw this for myself last July in visiting Saskatoon and Prince Albert, where although small sedimentation basins were provided the finer particles of the suspended matter remained in the water.

With reference to the use of a coagulant, I will quote from a report of the "Joint Special Committee to examine and report relative to the pollution of water supply, and the best method of filtration." City Document No. 15 of the City of Providence, R.I., as follows:—

"If the diameter of matter floating about in water is much less than that of the interstices between the grains of sand composing the filter-bed, such matter, except as much as is caught upon the sharp edges of the quartz, will go right through the filter with the water.

"Now, if a substance could be introduced, drop by drop, into the water before it comes to the filter-bed, which would have the effect of curdling the matter together, so that every one hundred or so of the smaller particles were made to join together and become one large particle, much as vapour or steam is condensed into drops, it would follow that they would be caught and held from going through the filter. This is accomplished by adding dissolved sulphate of alumina (Alum) to the water as it flows to the filter.

"The amount required is from almost none at all to about three-quarters of a grain, according to the state of the water, say, an average of from one-quarter to one-half gain per gallon in the ordinary condition of the Pawtucket River water.

"The action is the same as when coffee is cleared by means of the white of egg. No white of the egg goes to the drinker of the coffee—it is all drained out with the grounds; and, as no alum goes to the drinker of the water, it unites with the impurities in the water an setles in feathery flakes of insoluble hydrate on the top of the filter, and is washed out with its accumulation of impurities when the filter is cleaned.

"The analysis of the purified water shows no trace of the alumina used, while the analysis of the wash water shows that the alumina is all washed out with other impurities. This feathery bed of precipitate flakes produced by the alum forms a filtering material of insoluble mineral matter which is well nigh perfect in its character. Bacteria are like the very fine particles of clay of some water, so small as to pass the sand or quartz, but they are caught by the feathery precipitate of alumina hydrate, much as the bacteria contained in the air are prevented from entering a vial closed with sterilized cotton."

The above is an exact description of the use of a coagulant, and its importance in the use of a filter will be at once appreciated, when it is explained, that, one drop of alum in solution to one hundred thousand drops of water (about one-sixteenth of a grain to the gallon) is sufficient to render an average turbid water bright.

At Harrisburg we have the operating expenses for the year 1908, which are worth quoting, in view of the fact, that,

I give the results of the plant as a typical example of efficiency. The water commissioners of Harrisburg treat 3,358,029,150 gallons per annum, of which 3,271,732,550 were delivered to the pumps, and 86,246,600 gallons, or 2.6 per cent. of the whole was used in washing.

The annual cost for 1908 was as follows:

| | |
|---|---|
| Coagulant | $ 5,919.27 |
| Coal | 2,043.92 |
| Oil and waste | 207.30 |
| Supplies | 837.05 |
| Repairs | 639.89 |
| Laboratory | 1,305.76 |
| Labor | 8,209.33 |
| | $19,343.00 |

The above amounts to a charge of $5.91 per million gallons. Coagulant cost per million gallons $1.81, coal 62 cents, repairs 20 cents, laboratory, 42 cents, and labor $2.51.

This cost per million gallons at Harrisburg of $5.91 is a fair estimate of profitable cost when nothing is neglected to obtain efficiency. In certain cases the cost may be under this amount, in others over.

Now the assertion may be made, "But, this method of mechanical filtration is not a perfect one." Efficiencies are given of something over 99 per cent; but, what about the remaining bacteria which may be dangerous to health, and the percentage number of which remaining must depend upon the original number to start with? To this assertion, only one answer can be given. Science has not yet discovered any method which can guarantee absolute perfection in purification of water methods.

The fact that one hundred per cent. efficiencies have not yet been obtained in practice by any method of purification of water by filtration, has led to many experiments being made in sterilisation. It is admitted that any system of straining or filtering, even if added by the formation of a scum blanket, as in slow sand filtration, or by the addition of a coagulant, as in the case of mechanical filtration, will still allow some bacteria to pass which may or may not be injurious to the human system. It is natural, therefore, that the question has been asked. Is it possible to destroy all the bacteria in the water, by adding something to the water which will destroy the bacteria without injuring the water as far as its drinking properties are concerned? Experiments have been carried out for many years of applying different chemical forms of chlorine, both electrically and directly obtained, to water; as well as attempting to impregnate water by intensified forms of oxygen such as ozone, with the idea of disinfecting the water and rendering inert all properties of micro-organic character. While laboratory experiments have shown, that, it is possible to sterilise a water, absolute sterilisation has never been reached in practice. In dealing with large quantities of water, the difficulty has never been overcome, of reaching every particle of the water with the disinfectant. Further, in the case of water containing matters in suspension, it has been found impossible, in practice, to penetrate these matters so as to obtain absolute disinfection.

Disinfection or sterilization may be feasible as an adjunct or accessory to filtration; but as a method of purifying water, by itself, it is absolutely useless. For instance, if we could obtain a water entirely free from all suspended matter, and containing only organic matter in solution along with the presence of bacteria, then sterilisation might be effective. But no such water is ever placed before us to deal with, unless it has been first treated by efficient filtration. We, therefore, find that in all cases of so called sterilisation processes, filtration of the water is insisted upon as a primary necessity. We have a case illustrative of this point in Canada at the present time at Lindsay, Ontario. At Lindsay, there has been recently installed an ozone sterilising plant. The water is first treated by filtration, and then charged with the ozone gas. The filtration is only of a rough and ready character as it is expected that the ozone will do the real work. According to a recent analysis of the treated water, however, we find that the filters remove 67 per cent. of the bacteria, and that the ozone only removes a further 57 per cent of the bacteria from this partially clarified water. The total percentage removal of bacteria from the original water by the combined processes being only 87 per cent, or 8 per cent. below the standard required for mechanical filters.

In the above case, if filtration had been of an efficient character to remove the whole of, or practically the whole of, the suspended matter, the result might have been satisfactory, too much was asked of ozone, and two little of filtration.

The fact of the matter is, that up to the present, no data exist which will allow of a pronouncement in favor of sterilisation as opposed to filtration. On the other hand, sterilisation may be a useful and efficient addition to filtration in certain cases, where the original organic impurities are so high as to leave an undrinkable water with a bacterial removal of even over 99 per cent.

It must be remembered, that, one of the chief reasons for filtering water will always be the removal of sediment which causes turbidity and choking mains. All the methods of sterilisation, yet put forth, do not affect turbidity or matter in suspension, unless, aided by filtration. It must be filtration first, and the best that can be done by filtration; then if necessary, when all is filtered out that it is possible to filter, sterilisation may follow as a method of dealing with matter in solution or so minute that any filter cannot take cognisance of it.

## THE FLOW OF WATER IN PIPES, CULVERTS AND CHANNELS.*

### Being a Comparison of Different Formulæ in Common Use, and a Record of Some Recent Tests.

By Ernest H. Essex, A.M.I.C.E. (Graduate), Deputy Surveyor, Leyton.

Every municipal engineer is called upon more or less frequently during his professional career to make calculations for the discharge of sewers or water mains; the issue at stake is often of considerable importance, especially when the question of pumping arises, and it is, therefore, the more surprising to find such a difference of opinion existing as to the best formula to be used in the calculations. Not a little of this is due to experts and experimentalists endeavoring to supply a comprehensive formula which shall at one and the same time apply to such extreme cases as, say, a small channel formed with smooth-planed boards on the one hand, and the River Mississippi on the other; whereas the municipal engineer's requirements will probably be well covered by particulars as to pipes and culverts ranging up to 9 feet diameter. The author will endeavor to show that old original formula of Chezy* *—i.e., $V = C\sqrt{rs}$ is to this day the most **practical** formula to use, and it may not be out of place here to quote the following extract from a recent leader in one of our professional papers: "Formulæ are never essential, but often convenient. We would even go further and say that the misuse or abuse of formulæ is responsible more than anything else for unintel-

* Paper read before the Institute of County and Municipal Engineers, England.

**Throughout these notes all letters will have the following meaning:—

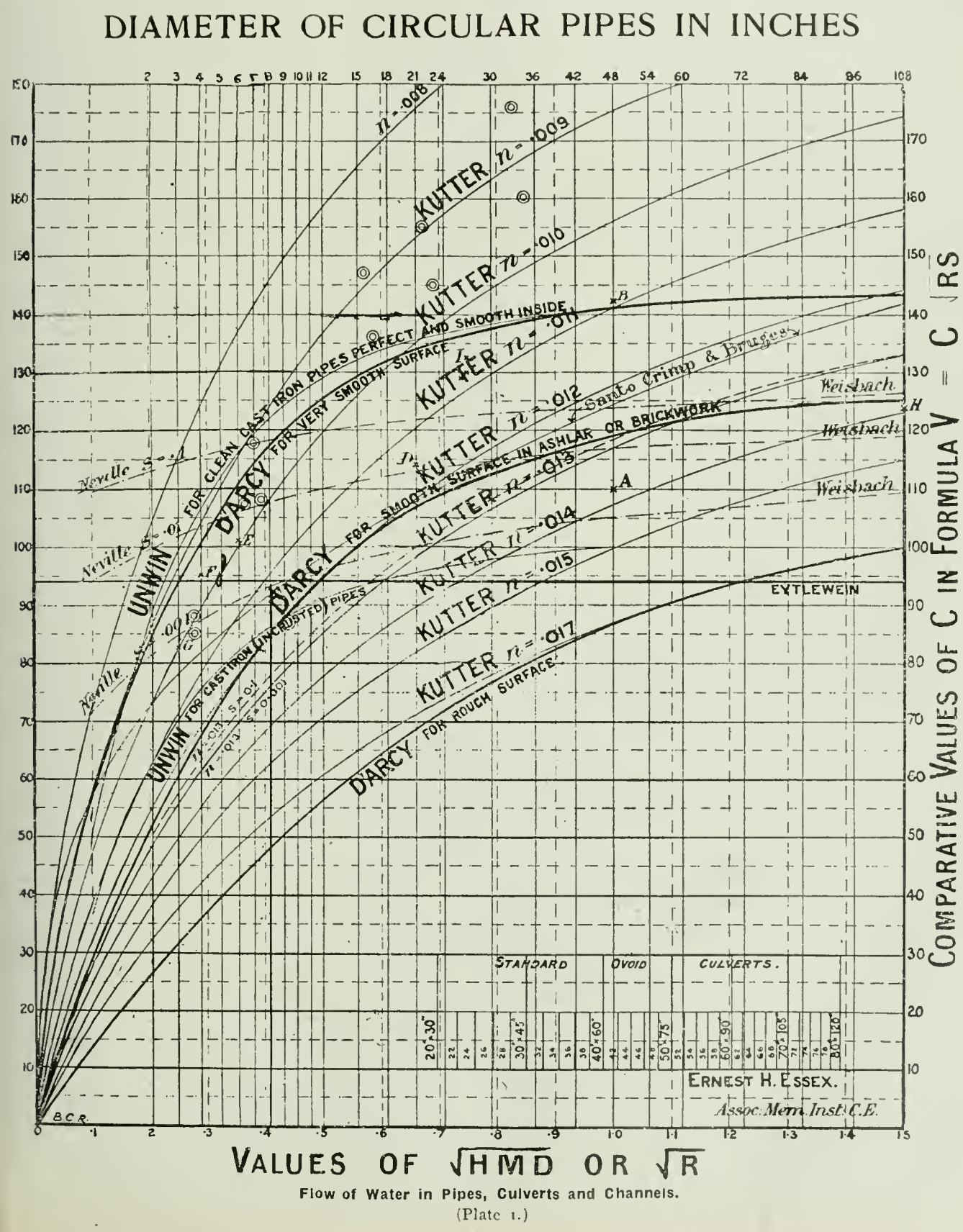
V = velocity in feet per second.
r = hydraulic mean depth in feet.
s = sine of slope.
n = coefficient of friction.
c = coefficient of entrance to pipe.

ligent engineering and bad text-books. The blind use of formulæ is to be deprecated; it is a reliance upon authority (often unknown), not on personal knowledge. When we believe a thing because somebody else has said it, we don't really know it, we only know that we think he thinks he knows it; this is wholly destructive of the scientific habit of mind, and is a growing evil in popular science. We do not mean that no one should use a formula without verifying it, but he ought to know whether it is absolute or empirical, and, if the latter, within what limits it is trustworthy, and on what experimental evidence it rests." Some engineers are quite satisfied to pin their faith to the Chezy formula, using Eytlewein's value of 94 for the empirical constant C or Beardmore's adaptation of the formula, $V = 55 \sqrt{r} \times 2f$, while others are content to use the tables in Molesworth's Pocket-book based on Neville's formula, $V = 140 \sqrt{rs} - 11^3 \sqrt{rs}$. Some are still in love with Weisbach's formula:—

$$V = \sqrt{\frac{2gH}{1 + e + \left(\frac{nx\frac{L}{4r}}{}\right)}}, \quad H = \left\{ 1 + e + \left( n \times \frac{L}{4r} \right) \right\} \frac{V^2}{2g},$$

$$n = 0{\cdot}01439 + \frac{0{\cdot}016921}{\sqrt{\quad}}, \text{ and } L = \text{length of pipe in feet}$$

probably because it looks somewhat imposing in print; but it would puzzle them to find much difference between the results obtained by this formula and that of Neville. In 1878




Flow of Water in Pipes, Culverts and Channels.
(Plate 1.)

this formula appealed so strongly to the eminent sanitary engineer, Mr. Baldwin Latham, that he was persuaded to publish in the second edition of his book "Sanitary Engineering" a revised set of tables based upon the following modification of it:—

$$V = \frac{64.4}{1.505 + \frac{nV}{4\sqrt{rs}}}$$

These tables have been, and the author is afraid still are, very largely relied upon by municipal engineers; it is, therefore, the more surprising to note that the formula might quite as well have been written $V = 100\sqrt{rs}$, and that had it been so written at that time it could never have appealed to a single engineer as possessing any practical value. Nevertheless, this knowledge confers distinct practical value upon these tables, because, the correct value of C having been determined, the percentage of error is at once apparent.

What we require to enable us to make accurate use of Chezy's simple formula is the correct value of the empirical constant C, which varies with different sizes of channel and different surfaces. A glance at Diagram I. will show that one curve line might be drawn applicable to a whole series of results of experiments in glazed pipes, but quite a different curve line would be needed to coincide with the results of experiments in brick sewers. The record of each set of experiments must be kept separate, and a separate curve line set up for each different class of channel. Now, the formula of Eytlewein and the modified form of Weisbach are what we might term one-line formulæ, and, therefore, of little practical use. The formulæ of Neville and Weisbach are multi-line formulæ, but the different lines do not represent different classes of channels, only different velocities in the same channel; they are, therefore, useless and misleading. The next formula given to us was that based upon D'Arcy's valuable experiments; this may be called a three-line formula, representing three different classes of channel, and it is of considerable merit. Its worst feature is its mathematical representation, which is—

$$V = \frac{1}{\sqrt{A\left(1 + \frac{B}{r}\right)}}\sqrt{rs}$$

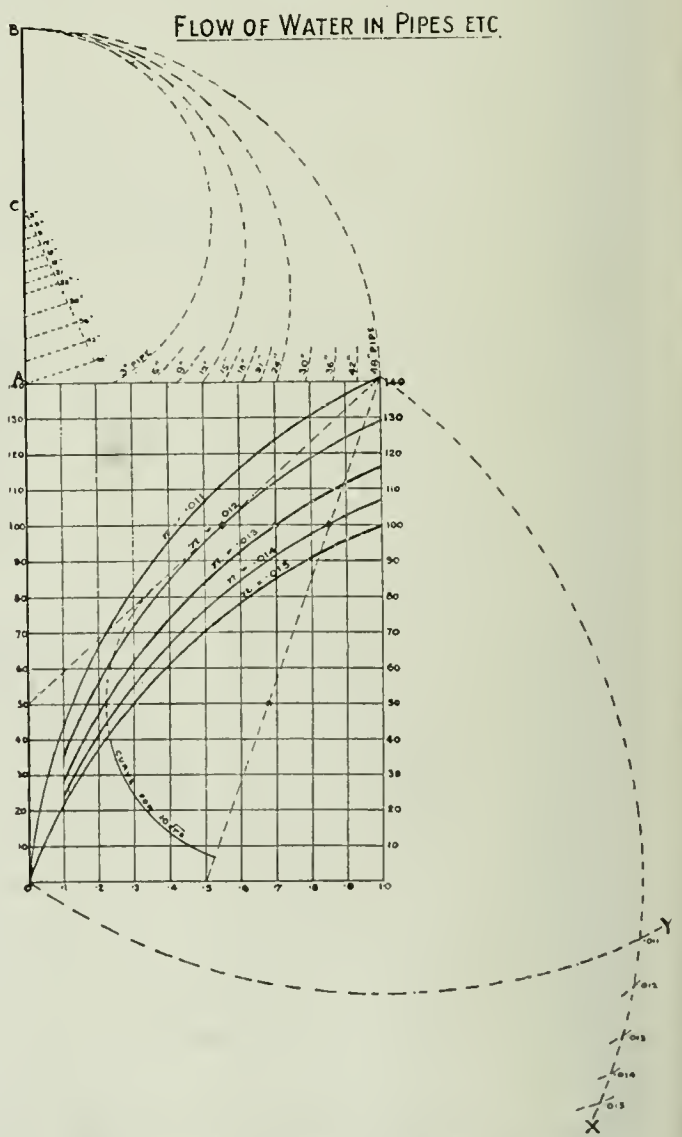
A and B being variable coefficients for different surfaces. Professor Unwin's formula is based upon D'Arcy's, being modified to suit the extensive experiments carried out by Dr. Riedler on the compressed-air mains of Paris. For water, steam, and compressed- air mains it is undoubtedly reliable, but, like D'Arcy's formula, it is something of a mathematical nuisance. There can be no doubt that the mathematician considers the municipal engineer fair game to be shot at, for on the top of all these abominations we have the following atrocity:—

$$V = \left\{\frac{\frac{1.811}{n} + 41.6 + \frac{0.00281}{s}}{\left(1 + 4.16 + \frac{0.00281}{s}\right)\frac{n}{\sqrt{r}}}\right\}\sqrt{rs}$$

which is supposed to represent the experiments carried out by Kutter. This is, indeed, a multi-line formula, for by adopting different values of n it can be made to cover the whole diagram. It must be called an active formula, but who can call it a practical one, unless it be used to express the results of our experiments in terms of Kutter? This was done by Mr. Santo Crimp in his paper to the Institution of Civil Engineers in 1895, where he stated that his experiments on the North London outfall culverts corresponded to a value of n in Kutter's formula equal to 0.0122, and that his experiments in a new brick semicircular channel corresponded to a value of n = 0.095. In these statements, however, Mr. Santo Crimp was not quite correct, for a glance at the diagram will show that the first case, point H, corresponds to n = 0.014, while the latter, point I, corresponds to n = 0.0109. The fact that so eminent an engineer could make an error of 15 to 20 per cent. in his estimation of the value of n in connection with his own experiments seems to point to the formula being a dangerous one to play with; but, being the latest mathematical toy, it is to be presumed that many engineers will continue to use it, and the most to be hoped for is that an occasional reference to the diagram will enable them to keep somewhere within the bounds of probability in making choice of the value of n to adopt, and the following table may, perhaps, prove useful also:—

**Table No. 1.—Average Values of n (Kutter).**

| Material. | Condition of Surface. Perfect. | Good. | Fair. | Bad. |
|---|---|---|---|---|
| Glazed stoneware pipe..... | 0.010 | 0.011 | 0.013 | 0.015 |
| Brickwork, ordinary ..... | 0.011 | 0.013 | 0.015 | 0.017 |
| Brickwork, glazed ..... | 0.010 | 0.012 | 0.013 | 0.015 |
| Rendering, cement mortar..... | 0.010 | 0.011 | 0.012 | 0.014 |
| Rendering, neat cement..... | 0.009 | 0.010 | 0.011 | 0.014 |
| Ashlar, dressed ..... | 0.013 | 0.014 | 0.015 | 0.017 |
| Cast-iron, coated ..... | 0.009 | 0.010 | 0.011 | 0.014 |
| Cast-iron, uncoated ..... | 0.010 | 0.011 | 0.012 | 0.014 |




**Flow of Water in Pipes, Culverts and Channels.**
(Plate 2.)

It is wise to pause here and reflect upon the many misleading statements that have been presented to the municipal engineer on this subject in the past under the cloak of mathematical formulæ, and consider how unconvincing much of it would have looked if put into diagram form at that time. We must not, however, be too ready to imagine that the increased use of diagrams can insure against the pro-

duction of further misleading mathematical formulæ of an empirical nature.

In 1895 Mr. Santo Crimp published another new formula, namely:—

$$V = 124^3 \sqrt{r^2} \times \sqrt{s},$$

and later still, Messrs. Saph and Schoder presented us with $V = 174\ r.^{67}\ s.^{54}$ as the one infallible formula for water mains. It is a source of wonder and great surprise that engineers can be found willing to countenance or adopt such proposals as these. What can a formula like Mr. Santo Crimp's possibly have to recommend it? A glance at the diagram shows it to be one of those practically worthless formulæ we have just now designated one-line formulæ; hence it is not surprising to find that it does not in any way coincide with his own experiments as indicated at points H and I. Mr. Lloyd-Davies, in an article to the Institution of Civil Engineers, in 1906, states that "Mr. Santo Crimp's formula has been demonstrated by experiments in Birmingham to be very accurate for sewers that have been in use for some time," and so spreads abroad a certain amount of credit for this impossible formula. The only experiment he quotes is that of a 4-ft. 6-in. sewer with about 1 ft. depth of flow, giving a result of C = 92 for a value of $\sqrt{r} = 0.418$, which is marked on the diagram with a **X**. Scaling, however, from the diagram accompanying the paper, we get a result of C = 87 for a value of $\sqrt{r} = 0.437$, marked on the diagram with a **O**. It is, to say the least, misleading to argue from this one experiment that Mr. Santo Crimp's formula is correct; we might just as well argue that the experiment proves Eytlewein's formula to be correct, which we know to be impossible; or we may argue that it proves D'Arcy's formula for brick culverts to be correct, which is more than probable. Again, as recently as 1907, Mr. A. W. Brightmore proposed yet another new formula for iron pipes, namely:—

$$V = \frac{112}{1 + \frac{3{\cdot}6}{d^2}} \sqrt{rs}$$

which he based upon the three experiments shown at points E, F, and G on the diagram. It is needless to comment upon the merits of this formula beyond remarking that it illustrates the extent to which the profession may suffer, unless it decidedly refuses to countenance any further matematical formulæ of an empirical nature. What the author does hope is that every municipal engineer reading this paper will determine to set up in his office a chart for different sewers, and mark thereon the value of C in Chezy's formula as found by him from any experiments he may make from time to time. Points marked on such a diagram present a number of distinctly interesting facts in a very concise manner; thus points A and B represent the value of the coefficient found by Desmond Fitzgerald in two 1,800-ft. lengths of 48-in. cast-iron water main, A showing the result after sixteen years, when the pipes were badly tuberculed, and B the improved result after the pipes had been scraped and cleaned, very closely approximating to the value found for the same pipes when new. Point D represents the value of C found by Mr. C. A. Friend for the discharge from five miles of 21-in. cast-iron water main after ten years' use. Points E, F, and G are the average of a number of tests carried out by Mr. A. W. Brightmore at the Royal Indian Engineering College on 3-in., 4-in., and 6-in. cast-iron pipes, clean but uncoated. Point H shows the value of C found by Mr. Santo Crimp from the discharge of the three 9-ft. brick culverts of the North London outfall after twenty-eight years' service, and point I the value found by him for the discharge in a 300-ft. length of new 3-ft. semi-circular channel constructed with hard bricks in cement finished to a perfectly smoth surface, with an inclination of 1 in 1,200, and flowing at a depth of about one foot.

The points indicated by the double circles represent the extreme values of the coefficient found by the author from a series of experiments carried out in a 250-ft. length of effluent channel at the Leyton sewage disposal works after the channel had been in use for five years. It was laid to a fall of 1 in 2,775, and constructed with a flat concrete invert, 6 ft. wide, rendered with cement mortar, and having red brick in cement side walls built to a batter of 1 in 2; the discharge was by floating arms from precipitation tanks of about 280,000 gallons capacity each, carefully measured to obtain the correct rate of flow, and took place through submerged pipes at right angles to the channel, the length of channel selected for the experiment being 350 ft. from the nearest tank outlet in order to modify as far as possible any effect from the initial velocity of discharge. The value of the coefficient compared with Kutter's formula will be seen to lie between n = 0.009 and n = 0.010. The mean velocity was tested with both limewater and permanganate of potash, and the value 0.83 of the observed central surface velocity was found to be consistently accurate. A short summary of the figures obtained is given in the following table. It may be noted that the observed depths of flow vary somewhat considerably from the calculated depths, and this indicates one of the greatest difficulties in conducting such experiments, and emphasizes the advantage of being able to measure the rate of discharge. It is also important to note that some proportion of the readings indicated a fall of ½-in. in the water level in the length of channel tested, which in the case of this very flat channel has the effect of altering the hydraulic gradient to 1 in 2,000, and would reduce the value of C to between n = 0.010 and n = 0.011.

**Table No. 2.**

| Channel 6 ft. wide. Fall 1 in 2,775. | Observed. Measured rate of discharge. Cubic feet per second. | Observed. Depth of flow. Inches. | Observed. Velocity of flow. Feet per second. | Calculated. Area of flow Feet | Calculated. Depth of flow. Inches. | $\sqrt{r}$ | Value of C. |
|---|---|---|---|---|---|---|---|
| November 4th—Eight tests—Highest | 0.2123 | 0.9 | 0.454 | 0.4676 | 0.929 | 0.275 | 87 |
| Lowest | 0.2123 | 0.95 | 0.443 | 0.4792 | 0.9521 | 0.2785 | 85 |
| November 6th—Eight tests—Highest | 0.8 | 1.7 | 0.82 | 0.9756 | 1.932 | 0.394 | 108 |
| Lowest | 0.8 | 1.7 | 0.77 | 1.04 | 2.06 | 0.407 | 98 |
| November 3rd—Eight tests—Highest | 0.783 | 1.7 | 0.863 | 0.907 | 1.79 | 0.381 | 118 |
| Lowest | 0.625 | 1.45 | 0.740 | 0.8446 | 1.667 | 0.3676 | 107 |
| October 31st — Four tests — Highest | 3.54 | 3.85 | 1.6 | 2.2125 | 4.31 | 0.570 | 147 |
| Lowest | 3.54 | 3.9 | 1.5 | 2.36 | 4.597 | 0.589 | 135 |
| October 31st — Four tests — Highest | 6.25 | 4.7 | 2.0 | 3.125 | 6.048 | 0.673 | 155 |
| Lowest | 6.25 | 5.3 | 1.9 | 3.289 | 6.367 | 0.690 | 145 |
| November 7th—Seven tests—Highest | 15.125 | 9.75 | 2.777 | 5.445 | 10.178 | 0.825 | 176 |
| Lowest | 15.125 | 10.0 | 2.594 | 5.831 | 10.899 | 0.8537 | 158 |

The author made himself a slide rule based on Chezy's formula, with an additional scale for correcting the value of C, which was found to be most convenient. Having obtained the value of $\sqrt{r}$ for each test, the slide was moved until this value came opposite the gradient figure 2,775, and the correct value of C read off on the scale opposite the observed velocity.

Just one word for the benefit of the many students connected with the association. Whenever presented with an intricate mathematical formula try to plot it in a line diagram, and it will be surprising how familiar the formula becomes. Consider the case of Kutter's formula. From the table on page 4 it will be seen that all ordinary cases are covered by values of n = 0.011 to n = 0.015, and it is not difficult to remember that in the case of a 4-ft. culvert where $\sqrt{r} = 1$, the value of C in Chezy's formula varies from 100 for n = 0.015 to 141 for n = 0.011. Take a sheet of squared paper (see Diagram II.), number the vertical lines 0 — 140, to represent values of the coefficient C in Chezy's formula, and the horizontal lines 0 — 1 to represent values of $\sqrt{r}$. From centre 0, with radius 0 — 141, describe the arc 141 — x, and from centre 141 with same radius describe the arc 0 — Y; from the point of intersection, still using the same radius, describe the curve 0 — 141, which represents the values of C for n = 0.011. From point 100, with same radius, intersect the arc 0 — x as shown, and from this point as centre describe the n = 0.015 curve. From the three points shown on the 100 line (the positions of which once studied can never be forgotten), intersect the arc 0 — x as before, and still with the same radius describe the other three curves, and the diagram is complete for the five curves. After constructing such a diagram twice or three times, any student could set it up in five minutes in the examination-room. Note also the easy method of finding graphically the values of $\sqrt{r}$ for circular pipes at the top of the diagram. AB is a line, one unit in length, at right angles to the 140 line, upon which we desire to set out our values of $\sqrt{r}$. CA, therefore, equals 0.5, which is the value of $\frac{r}{2}$ for a 48-in. pipe; divide CA into forty-eight parts, and it represents the value of $\frac{r}{2}$ for any other diameter in inches, measuring from C. With centre at A and radius AB we obtain the value of $\sqrt{r}$ for a 48 in. pipe; with centre 24 and radius 24 — B, we obtain the value of $\sqrt{r}$ for a 24-in. pipe, and so for all sizes.

Join diagonals 141 — 50 and 141 — 0.5 as shown, and from the point of intersection of line 50 with diagonal 141 — 0.5 as centre, and with radius touching diagonal 141— 50, describe the curve shown. Within the limits of line 40 and diagonal 141 — 0.5 this curve will give very accurate readings of $10\sqrt{rs}$ on the horizontal line, for all values of $\frac{L}{d}$ read on the vertical line; L being the length of sewer required for a fall of 1 ft., and d the diameter of the pipe in inches. Thus, in the case of a 12-in. pipe with a fall of 1 in 300, $\frac{L}{d} = 25$; we find from the diagram that $\sqrt{rs} = 0.0295$, and if the value of n is taken at 0.013, C = 85; therefore, V = 85 × 0.0295 = 2.5 ft. per second, which is certainly preferable to attempting to work the mathematical formula presented to us.

In conclusion, the author desires to express the hope that this paper may be found to comprise a fairly complete and reliable summary of the best available information hitherto published with reference to the subject under consideration, and enable the busy engineer to readily acquire a wider grasp and comprehension of the relative value and importance to be attached to the various arguments upon the question which may be laid before him. The present incomplete record of the results of reliable experiments is a certain guarantee that fresh argument will still be forthcoming, but if this paper may in any way assist to minimize the undue importance given to arguments only slightly affecting the question, the consideration of which but tends to the confusion of that clear issue which should be the sole desire of everyone, the author will feel amply compensated for any trouble he has taken. It is quite certain that the simplification of the problem rests in the hands of the Association, so many of whose members have charge of sewers and culverts delivering into or out of storage and disposal tanks where the rate of discharge can be accurately measured, and water mains where the hydraulic pressures during discharge can be readily obtained. Particulars of reliable tests, if forwarded to the secretary, could be readily examined and plotted on a chart, which should ultimately prove of inestimable value.

It has been the author's endeavor throughout to emphasize most strongly his view that in all cases of empirical formulæ it is the experiments upon which such formulæ are based which are likely to prove of real value, while the formula itself may eventually prove, owing to its necessary limitations, to be inaccurate and misleading. In attempting this he trusts he will have given offence to none, but that many engineers will be found of the same opinion, and many others converted to it.

## NATIONAL TRANSCONTINENTAL RAILWAY.*

**Duncan MacPherson, M. Inst. C. E.**

An act respecting the construction of a National Trans-Continental Railway was assented to by the Dominion Parliament on October 24, 1903, which provided for the construction of a line to be operated as a common railway highway across the Dominion of Canada from ocean to ocean, and wholly within Canadian territory.

This line was, by the Act, divided into two distinct parts—the Eastern Division, from Moncton to Winnipeg, to be constructed under a Government Commission; and the Western Division, to be constructed by the Grand Trunk Pacific Railway Company, extending from Winnipeg to the Pacific Ocean.

The Act provides that the Eastern Division shall be built from the eastern terminus at Moncton through the central parts of the Province of New Brunswick and through the Province of Quebec, by the shortest available line, to the city of Quebec; then westerly through the northern part of the Provinces of Quebec and Ontario, and through the Province of Manitoba to the city of Winnipeg; according to such plans and specifications as may be determined, having due regard to directness, easy gradients, and favorable curves.

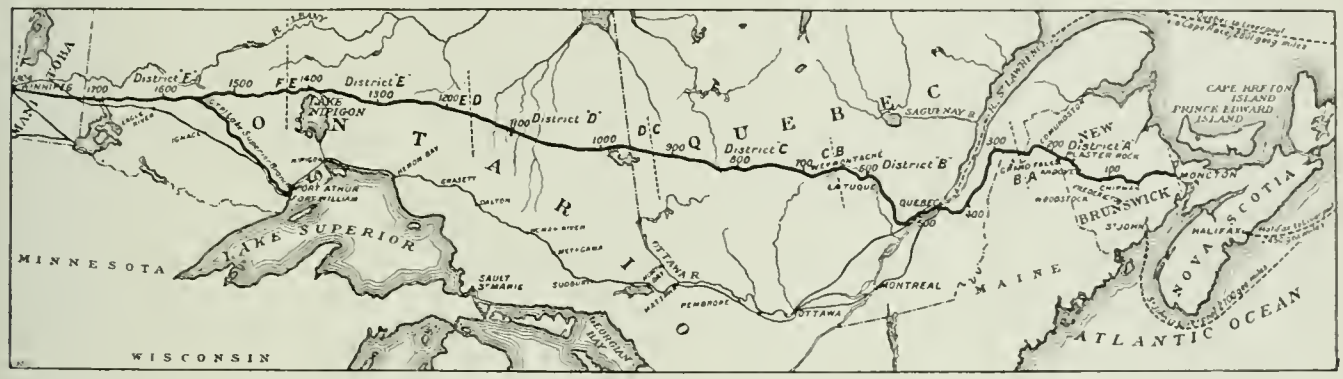
The Commissioners and Chief Engineer were appointed by Order-in-Council, August 20, 1904, and met within a few days for organization. One of the first questions to determine was in regard to the survey work to be undertaken, during the autumn and winter, on that portion of territory not covered by the Grand Trunk Pacific Railway parties who were out east of Winnipeg, in the direction of and nearly up to Lake Abitibi. It was decided to form the territory between Moncton and near longitude 84 degrees into four districts—"A," "B," "C," "D"—"A" from Moncton to the boundary between the Provinces of New Brunswick and Quebec, supposed to be about 290 miles; "B" from the boundary to Clear Lake, about 420 miles; "C" to the provincial boundary between Quebec and Ontario, about 300 miles; "D" to near longitude 84 degrees, about 240 miles.

Soon after these four districts had been formed the Commissioners arranged to take over from the Grand Trunk Pacific the survey parties east of Winnipeg, with their supplies, plans, profiles, etc., and organized two more districts "E" and "F," thus covering the whole distance between Moncton and Winnipeg. District "E" extends about 265 miles westerly from west boundary of "D" to a point about 30 miles west of Lake Nepigon. District "F" extends from this point to Winnipeg, about 385 miles. The

*Read before the British Association for the Advancement of Science, Winnipeg, 1909.

total distance from Moncton to Winnipeg was estimated to be about 1,900 miles, on what was assumed to be the most direct feasible route. The problem to be solved of definitely locating this most direct and feasible route was not an easy one, when it is remembered that for more than half the distance the line of general directness ran through an unsurveyed, unsettled, and practically unknown region, cut up in all directions with a network of lakes and rivers, many of them not shown on any existing maps, and, when so indicated, often found to be entirely misplaced. Our engineers had, therefore, in many cases to make their own maps as the surveys proceeded, and in all cases to correct and complete existing maps.

During the autumn of 1904 and the following spring some thirty-four survey parties were equipped and sent out, and before the end of 1905 there were forty-five parties in the field, consisting of about eighteen men each, not counting a large number of men engaged in transporting supplies by canoe and packing in summer, and by dog train in winter. Each survey party had an engineer-in-charge, transitman, leveller, topographer, draughtsman, rodman, picketman, and two chainmen, cook and eight or nine axemen and packers. Each party was given certain governing points to connect, and instructed to thoroughly exhaust the possibilities for the most favorable and reasonably direct line between these points. Barometric explorations and compass lines were followed by preliminary lines run with transit, and plans were plotted with 10-ft. contours on a scale of 400 ft. per inch.




With these plans and profiles on the same scale, projected locations were made on the most favorable lines, and afterwards actually run on the ground, and called a "first location." These plans and profiles were plotted in the field, and tracings, with reports, sent to headquarters monthly. These reports were carefully gone over by the chief and assistant chief engineer, necessary changes suggested, and instructions issued accordingly. Whenever the head of a party completed what he considered the best possible first location, the engineer-in-charge was changed, and another man given a chance to improve the line by making his best attempt at a revised location. The original head of the party, or a third man, was given a chance to still further revise for a further location. In this way it was found that a healthy rivalry was established, and good results obtained. Revision of location is, however, never considered as finished until construction work is well under way, as it is often found, after the line is cleared, that slight changes will effect a very considerable saving. An equation table giving definite values for savings in distance, curvature, rise and fall etc., was furnished all parties in the field, so that, having the estimated cost of construction of any two or more lines, the better one to adopt from all points of view could be at once determined. Copy of equation table annexed.

Maximum Curves.—The maximum curve used is 6 deg. (radius, 955 ft.), and is only used sparingly where the topographical conditions prohibit an easier radius with reasonable cost. All curves of 1 deg. (radius, 5,730 ft.) and sharper are connected to their tangents with easy spirals.

The maximum grades decided upon are, so far as the writer is aware, the easiest on any transcontinental line in America, being on tangents 0.4 per cent. =21.1 ft. per mile adverse to the major or east-bound traffic, and 0.6 per cent. = 31.68 per mile against the comparatively minor west-bound traffic. These maximum grades are used sparingly, and only for the purpose of avoiding heavy work. On curves the grades are reduced 0.04 ft. per degree in the index of the curve, so that on the maximum curve of 6 deg. the maximum east-bound grade would be 0.4 minimum 6 × 04 = 0.16 per cent., or 8.44 ft. per mile.

The whole line between Moncton and Winnipeg, with the slight exception of short approaches to the Quebec Bridge on 1 per cent. grades, was definitely located with the above-mentioned very easy maximum grades; but at one point in New Brunswick, at mileage 146 from Moncton, it was found that, by the insertion of about 12½ miles of 1.1 per cent. grade adverse to east-bound traffic a saving could be made of 17.2 miles in distance, nearly $2,000,000 in construction, $1,250,000 in capitalised operating value.

At another point in Quebec, near mileage 286 from Moncton, a similar grade, about 10 miles long, adverse to west-bound traffic, was found to effect a saving of 18.8 miles in distance, about half a million in construction, and over three-quarters of a million dollars in capitalised operating value. These possibly temporary grades were adopted with the corresponding saving in distance and cost. If the future traffic of the road justifies the expense, these two short links of standard grade can be built at any time.

The proviso for directness of alignment proved a very wise precaution, as, in the province of New Brunswick especially, the people inhabiting the fertile, well-settled, St. John River Valley, very naturally desired to secure the advantages which would accrue to their beautiful section of country by the construction of a trans-continental railway. the fact that this would unnecessarily lengthen the line by 29 miles—a most important factor on a through route—did not appeal to them as strongly as to the inhabitants of the more western provinces, anxious to secure the best possible outlet for the rapidly increasing volume of freight from the greatest potential wheat-fields of the world. Fortunately, our engineers were able to prove that the direct line would not only be much shorter, and effect a great saving in operation, but also that the total cost of construction would be very considerably less. An additional factor in favor of the direct line was the openng up new territory not hitherto enjoying railway facilities, whereas the St. John Valley is already served by the Canadian Pacific, and, to some extent by the Intercolonial Railway.

The surveys being well advanced for some distance east of Winnipeg and west of Quebec, tenders were called for, closing on March 12, 1906, for 150 miles of line from the north side of the St. Lawrence, at Cap Rouge westward, and for a steel viaduct 3,000 ft. long, 150 ft. high, across the Cap Rouge Valley; also for 245 miles from near Winnipeg to Peninsula Crossing, near the proposed junction with the Fort William branch of the Grand Trunk Pacific Railway. This branch line had been under construction for some time, and the intention was that, as soon as it and the portion of the main line between the junction and Winnipeg was completed, to start operating between Fort William, Winnipeg and west, thus giving another outlet to the Great Lakes from the western wheat-fields.

The summer of 1906 was a busy one in railroad construction all over the continent of North America, the result being that wages rose to the abnormal rate of $2.50 per day for unskilled labor, and even then good men were almost impossible to obtain, so that progress was not as fast as was anticipated on the first two main contracts let. The financial depression of 1907 proved, in some ways, a blessing in disguise to railway contractors; as only roads which were strong financially were able to do any new construction, men were more plentiful and at reduced wages. From time to time, as the final location was completed on different sections, new contracts were let until, on October 29, 1908 the last contracts were let on districts "D" and "E" In the summer of 1908, an army of 21,000 men were working on the various contracts between Moncton and Winnipeg. The originally estimated distance of 1,900 miles between these points had been reduced gradually by repeated revisions of location at various points to a distance of 1804.8 miles. This distance is 261 miles less than the shortest distance over any other combined railways between Moncton and Winnipeg. The distance between Winnipeg and Quebec City, over the Trans-continental Railway, will be 1,351 miles, which is 223 miles shorter than the Canadian Pacific Railway, and the grades are so much more favorable that engines of equal capacity should haul nearly twice the load on the former line that they could on the latter.

Transportation of grain by water has always been much cheaper than by rail, but the latter has been slowly and surely cheapening until the present time, when the easy gradients and tremendously powerful locomotives of modern lines will make a combination on land, difficult to excel, or peradventure to equal, on water.

The distance from Winnipeg to Quebec via Canadian Pacific Railway to Fort William and Lake Canal and St. Lawrence River to Quebec is 1,771 miles, involving five trans-shipments of wheat. The distance on the Trans-continental Railway will be 1,351 miles, and, as the maximum east-bound grade is 21.12 ft. per mile, compensated for curvature, the heaviest locomotives built to date—a Mallet articulated compound, fully described in the Railway Age Gazette of April 30, 1909—is capable of hauling, on this grade, a gross load behind the tender of 4,290 tons, Assuming the tare 33⅓ per cent. of gross load, the net paying load would be 2,860 tons, equal to 95,333 bushels of wheat, in one train. If we assume the earnings of such trains to be $4.40 per train mile, or exactly double the earnings of the Canadian Pacific Railway freight train-miles for 1908, we find the cost per bushel over the 1,351 miles between Winnipeg and Quebec to be 4.25 cents. The lowest rate that the writer is aware of having been in force from Fort William to Montreal, via the Lake Canal and St. Lawrence River, a distance of 1,216 miles, was 4 cents per bushel in 1908. This 4 cents per bushel for 1,216 miles would be equivalent to 4.44 cents for 1,351 miles, so that at $4.40 per train-mile the engines above referred to could haul grain on the Trans-continental Railway, east-bound from Winnipeg to Quebec, for 0.19 cent per bushel cheaper than the cheapest existing water route could haul it the same distance, and 10.86 cents per bushel cheaper than the present combined rail and water rates betwwen the two points in question. In brief, at about one-quarter the present rail and water rate.

It would appear that the days of the absolute supremacy of water transportation were in danger of at least a partial eclipse. Owing to the comparative inaccessibility of parts of the line, about 300 miles of it are yet actively under construction, though roads are being made and supplies put in, so that by the end of the year the whole line, not already finished, will be covered with workmen, rock-drills, steam-shovels, and all the necessaries of modern railway construction. In order to keep check on the rate of progress of the work the writer introduced on this line percentage forms of reports, being notifications and extensions of similar forms in use on the Canadian Pacific Railway. Form 127, sample annexed, is returned to the writer monthly by the division engineers through the district engineers, and it is then graphically plotted on the diagram, sample annexed, which shows at a glance not only the percentage done during the month on grading, ballasting, and all the other items of construction, but also shows the percentage done to date under each of these headings, and the percentage done of the whole work in each main contract. This form of report has been found invaluable as an aid in answering requests for information from the House of Commons when in session, and for compiling our annual reports.

Our engineering organization consists of a chief engineer and assistant chief engineer, bridge engineer, district engineers, each in charge of a district from 250 to 400 miles long; division engineers, in charge of from 40 to 50 miles; resident engineers, in charge of 10 to 15 miles.

The annexed map, together with the foregoing general description, will, it is hoped, give a fair idea of the methods pursued in locating and constructing a great transcontinental line through a partial wilderness.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7735—August 6—Recommending to Government-in-Council for approving by-law of C.N.R., with respect to spitting and smoking in railway cars and premises.

7736—August 6—Authorizing the Canadian Northern Quebec Railway to construct its railway across the public road between lot 624 and lots 622 and 623 Parish of St. Timothee, Que.

7737—August 6—Authorizing the C.N.Q.R., to construct its railway across public road between lots 162 and 159, Parish of St. Timothee, Que., at mileage 76.15 west from Quebec Bridge.

7738—August 6—Authorizing the Hazeldean Rural Telephone Company to construct its wires across the tracks of the C.P.R. at Stittsville Station, Ont.

7739 and 7740—August 5—Authorizing the Bell Telephone Company to erect its wires across the tracks of the G.T.R. at Ouimet Avenue, St. Laurent, Que., and at Daniel Street, Arnprior, Ont.

7741—August 5—Authorizing the Moosomin East Rural Telephone Company to erect its wires across the tracks of the C.P.R. between Section 27 and 34, Township 13, R. 31, W. 2 M., Saskatchewan.

7742—August 5—Authorizing the Leeds and Grenville Telephone Company, Ltd., to erect its wires across the tracks of the C.P.R. at Spencerville crossing on the Prescott and Ottawa branch.

7743 and 7744—August 5—Authorizing E. Blanchard, M.D., of Cannington, Ont., to erect telephone wires across the tracks of the G.T.R. at 11th Concession, Township of Brock, and at the side line south of Laidlaw Street, Cannington, Ont.

7745—August 20—Authorizing the C.P.R. to construct its railway across the road allowance known as the Banff Trail near Anthracite, Alta.

7746—August 5—Approving of location of the C.N.R. from Sec. Tp. 15, R. 17, W. of the 6th M., to Section 11, Township 14, R. 17, W. of the 6th M., mileage 0. to 5, B.C.

7747—July 23—Amending order No. 6538, dated March 18th, 1907, with respect to steel rolled tires on locomotive wheels.

7748—August 3—Authorizing the Bell Telephone Company to erect wires across the tracks of the C.P.R. at public highway crossing at about 600 feet west of mileage 49 (west of Webbwood, Ont.).

7749—August 7—Staying proceedings under Order 7394, dated June 28th, 1909, with respect to the G.T.R. station at Guelph, Ont., until question of subway at Neeve Street is disposed of.

7750—August 10—Authorizing the Thedford, Arkona and East Lambton Telephone Company, Ltd., to erect its wires across the tracks of the G.T.R. at Thedford, Ont.

7751 to 7753—**August 10**—Authorizing the Bell Telephone Company to erect its wires across the tracks of the C.P.R. and G.T.R. at three different points.

7754 to 7756—**August 10—Authorizing** the British Columbia Telephone Company to erect its wires across the tracks of the Esquimalt & Nanaimo Railway at 41 mile post near Duncans, B.C.; at the Quamichum Lumber Compnay's Saw Mills, near Duncans, B.C.; and at Evan's private crossing, near Duncans, B.C.

7757 to 7759—August 6—Authorizing the Hazeldean Rural Telephone Company to erect its wires across the tracks of the C.P.R. at a point three miles east of Stittsville Station, main line, at a point six miles east of Stittsville Station, and at a point five miles east of Stittsville Station, Ont.

7760—August 10—Authorizing the Claremont and Ashburn Telephone Company to erect its wires across the tracks of the G.T.R. at Mill Street, Brooklin, Ont.

7761—August 10—Authorizing the C.P.R. to construct a highway bridge carrying First Street, Brandon, Man., over Assiniboine River and C.P.R. yard at that point.

7762—August 10—Authorizing the Grand Trunk Pacific to construct its railway across highway between Sections 10 and 11, Tp. 36, R. 15, W. 3rd M., district of West Saskatchewan.

7763—August 6—Authorizing the C.N.Q.R. to construct its railway across public road between lots 624 and lot 27-12. Parish St. Timothee, Que., at mileage 77.11, west from Quebec bridge.

7764—August 10—Authorizing the Grand Trunk Railway to construct a branch line to the Blaugas Co., of Canada, in Parish of Montreal, lots 3409 and 3410.

7765—August 10—**Granting leave** to the Hamilton Cataract Power, Light & Traction Company, to erect, place, and maintain, its electric light wires across the track of the G.T.R., north of Desjardins Canal, Hamilton, Ont.

7766—August 10—Granting leave to the Saskatchewan Government to erect its wires across the track of the C.N.R. between Sections 24 and 25, Tp. 25, Range 29, West 2nd Meridian, Sask.

7767—August 7th—Ordering that the legal switching rate chargeable upon the cars switched by the M.C.R.R. for the Canada Iron Corp., Ltd., of St. Thomas, Ont., from the G.T.R. tracks to their works, between the dates July 19th, 1907, and June 4th, 1908, inclusive, was $3 a car, and the difference between this rate and $6 per car between the dates in question be refunded by the railway company.

7768—August 7—Dismissing complaint of C. W. Stewart, of St. John, N.B., complaining that he is unable to market cornmeal in consequence of an alleged discrimination by the C.P.R. in favor of his competitors and to his disadvantage.

7769—August 12—Granting leave to the Government of the Province of Alberta to place its wires across the track of the Alberta Railway and Irrigation Company at a point between Sections 6 and 9, Tp. 4, Range 24, West 4th Mer.

7770 to 7775—August 12—Granting leave to the Government of the Province of Alberta to place its wires across the track of the Alberta Railway and Irrigation Company at one point, and across the C.P.R. at five points in the Province of Alberta.

7776—August 12—Granting leave to the Bell Telephone Company to place its wires across the C.P.R., 1½ miles east of Durham Station, Ont.

7777 to 7779—August 12—Granting leave to the Bell Telephone Company to place its wires across the C.P.R. at two points and the G.T.R. at one point in Ontario and Quebec.

7780 and 7781—August 12—Granting leave to the Ingersoll Telephone Company to place its wires across the track of the C.P.R. on the First Con. road between Lots 1 and 2, Tp. of West Zorra, County of Oxford, Ont., and between 3rd and 4th Con. between Lots 1 and 2, Tp. of West Zorra, County Oxford, Ont.

7782 and 7783—August 10—Granting leave to the Government of the Province of Saskatchewan to place its wires across the C.N.R. between Sections 2 and 27, and 17 and 18, Tps. 24 and 25, Range 28, West 2nd Mer., Prov. of Sask.

7784—August 10—Authorizing the C.P.R. to construct, maintain and operate branch line to and into the premises of J. D. Clark & Company, Winnipeg, Man.

7785—August 12—Granting leave to the Rural Municipality of Pipestone to place its wires across the track of the C.P.R. at P.C., 3½ miles N.W. of Reston, Man.

7786—August 7—Granting leave to the G.T.R. to appeal to the Supreme Court of Canada from Order of the Board, No. 7613, dated 22nd July, 1909, directing that they provide station accommodation at or near the point where the G.T.R. Company's lines from the City of Hamilton to Niagara Falls, cross the town line between the Tps. of Clinton and Louth, County of Lincoln, Ont.

7797—August 7—Directing the Red Mountain Railway to provide and construct a suitable highway crossing over its track at a point a little south of Patterson's Station, B.C.

7788—August 7—Granting leave to the Municipal Corp. of the village of Glencoe, Ont., to place its electric light wires across the track of the G.T.R. in the said village.

7789—July 26—Authorizing the C.N.Q.R. to construct, maintain and operate spur to and into the premises of Warden, King & Sons, Ltd., at Maisonneuve, P.Q.

7790—August 16—Amending Order of the Board, No. 6535, dated March 18th, 1909, by inserting the words "or steel-rolled" after the words "steel tire," in the fifth line of the operative part of said Order.

7791—August 10—Authorizing the Corporation of the City of Vernon, B.C., to lay and thereafter maintain sewer pipes under the track of the Shuswap & Okanagan branch of the C.P.R., where the same crosses South Vernon, Schubert and Seventh Streets, Vernon, B.C.

7792—August 17—Authorizing the G.T.R. to construct, maintain and operate branch line to and into the premises of the Gull Lumber Company on Lot 16, Tp. of Bexley, Ont.

7793—August 17—Authorizing the C.P.R. to construct, maintain and operate industrial spur into the warehouse of the Farmers' Grain & Supply Company at Wauchope, Sask.

7794—August 16—Authorizing the C.P.R. to construct, maintain and operate two branch lines of railway in the Tp. of St. Boniface, Man.

7795—August 17—Granting leave to the C.P.R. to construct a second line of its railway between Bolton & Bolton Junction in the Tp. of Albion, Ont.

7796—August 17—Authorizing the C.P.R. to construct, maintain and operate spur to and into the premises of J. Eveleigh & Company, Montreal, P.Q.

7797—August 17—Authorizing the C.P.R. to construct bridges at mileages 110.3 and 110.6, on the London section of its line.

7798—August 12—Granting leave to the Manitoba Government Telephone to maintain its wires across the track of the C.P.R. at P.C. ¼ mile west of Findlay, Man.

7799—August 13—Granting leave to the Thamesville Telephone Company to erect, place and maintain its wires across the track of the C.P.R. (Ontario & Quebec Railway Company) at North Thamesville, Ont.

7800 to 7802—August 13—Granting leave to the Government of the Province of Alberta to cross with its wires the track of the C.P.R. between Sections 2 and 3, Tp. 25, R. 1, West of the 5th Mer., Alberta, and at Section 3, Tp. 7, R. 20, West of the 4th Mer., Alberta; also at a point 4½ miles east of Camrose, Alberta.

7803 and 7804—August 13—Authorizing the Government of the Province of Alberta to erect its wires across the tracks of the C.P.R. at Osler Street, Carstairs, Alta., and at Hillcrest Station, Alta.

7805—August 13—Authorizing the Government of the Province of Alberta to erect wires across the tracks of the C.P.R. at two miles west of McLeod, Alta.

7806 and 7807—August 13—Authorizing the Bell Telephone Company to erect its wires across the tracks of the London & Port Stanley Railway Company at public crossing

at White Station, Ont., and across the G.T.R. tracks at public crossing at Preston Street, Ottawa, Ont.

7808—August 13—Authorizing the Golden Flat Rural Telephone Company, Ltd., to erect its wires across the tracks of the C.P.R. between Sections 13 and 14, Tp. 15, Range 23. West of 2nd Mer., Saskatchewan.

7809 to 7812—August 13—Authorizing the Volcanic Oil and Gas Company to lay and maintain pipe line to convey natural gas under the tracks of the Michigan Central and Pere Marquette at four different points.

7813—August 13—Authorizing the City of Toronto to construct bridge to carry the highway and tracks of the Toronto Street Railway Company over the tracks of the C.P.R., G.T.R. and C.N.O.R., where such tracks cross Queen Street East, in the City of Toronto, apportioning the costs maintained. Detail plans of bridge and approaches to be submitted to the Board's engineer by the 15th of September, 1909; bridge to be constructed, ready for traffic by July 1st, 1910.

7814—August 16—Authorizing the G.T.R. to construct a branch line extending from a point on its line of railway between Orillia and Midland at or near Tiffin, and running in a southerly direction through the townships of Tiny and Tay to the road allowance between Lots Nos. 91 and 92, in the 2nd Concession of the Township of Tiny, County of Simcoe, Ont.

7815—August 16—Authorizing the G.T.R. to construct branch line extending from a point on its line of railway, near the corner of Victoria Street and Fourth Street, in the town of Midland, Ont., and running in a westerly direction partly through the town of Midland, the townships of Tay and Tiny, and the town of Penetanguishene, to a junction with the Penetang branch of G.T.R. at or near Queen Street in the town of Penetanguishene, Ont.

7816—August 16—Authorizing the G.T.R. to construct branch extending from a point on its line of railway between Colwell and Penetanguishene, near Wyevale, township of Tiny, and running in a northerly direction to the road allowance between Lots Nos. 91 and 92, 2nd Concession, township of Tiny, Ont.

7817—August 20—Extending until the 1st day of November, 1909, the time in which the branch line authorized by Order No. 6365, dated January 27th, 1909, was to be constructed by the C.P.R. and C.N.O.R. in the town of Parry Sound, Ont.

7818—August 16—Approving Local Standard Passenger Tariff C.R.C. No. 7, of the Alberta Railway & Irrigation Company, superseding C.R.C No. 5, providing for a rate of three cents per mile.

7819—August 18—Approving revised location of the C.P.R. Crows Nest branch between Pincher and Coleman, from a point in Section 12, Tp. 7, Range 1, west of the 5th Mer., to a point in Section 3, Tp. 8, Range 4, west of the 5th Mer., Alberta, being from mileage 31.60 to mileage 37.56, and from mileage 53.42 to mileage 56.02.

7820—August 17—Authorizing the Council of the township of Humberstone, Ont., to lay a culvert under the tracks of the G.T.R. on Lot 25, Concession 3, Tp. of Humberstone, Ont.

7821—August 17—Authorizing the Bee Line Rural Telephone Company, Ltd., to erect its wires across the tracks of the C.P.R. between Sections 25 and 26, Tp. 20, Range 11, West of 2nd Mer., Province of Saskatchewan.

7822—August 17—Authorizing the C.P.R. to construct spur to premises of J. Y. Griffin & Company, Ltd., Winnipeg, Man.

7823—August 17—Authorizing the C.P.R. to construct spur to Tudhope, Anderson & Company, Ltd., Winnipeg, Man.

7824—August 17—Authorizing the C.P.R. to construct spur to the Alpha Company, Ltd., St. Phillippe Ward, Three Rivers, Que.

7825—August 17—Authorizing the C.P.R. to close the temporary crossing at Third Avenue and that portion of First Avenue crossing the right of way of C.P.R., and to rearrange its general yard at Moose Jaw, Sask. Also to open up a temporary crossing at Fourth Avenue.

7826—August 20—Authorizing the C.P.R. to construct spur into the premises of the Imperial Oil Company, Ltd., at Wetaskiwin, Alberta.

7827—August 20—Authorizing the C.P.R. to construct bridge over Dufferin and Lisgar streets, at Chapleau, Ont.

7828—August 16—Amending order No. 7639, dated July 27th, 1909, by striking out the words "Toronto Section," in item 5 of the operative part of the Order, and substituting therefor the words "St. Maurice Valley Branch."

7829—August 18—Amending Order No. 6084, dated January 14th, 1909, by not requiring train No. 68, of the C.P.R., to stop at the crossing of the Canadian Northern Quebec Railway at St. Jerome, on Monday's.

7830—August 20—Authorizing the town of Listowel, Ont., to lay and maintain watermain under the tracks of the G.T.R., on Mill Street.

7831—August 20—Authorizing the Robitaille-Eureka Distillery, Ltd., to lay a one-inch water pipe across the tracks of the Quebec Railway, Light and Power Company, at Beauport, near Quebec.

7832—August 20—Authorizing the G.T.R. to reconstruct bridge No. 50, at mileage 136.94, over Holland Avenue, 1.16 miles west of Chaudiere Junction, Ont.

7833—August 19—Approving location of the Canadian Northern Railway, Greenway Branch extension, Adelpha to Wassena, through Township 2, Ranges 19-21 West Principal Meredian, mileage 52.11 to 64.77.

7834 and 7835—August 20—Authorizing the City of Revelstoke, B.C., to lay box drain under track of the smelter and old wharf siding of C.P.R. on Second Street and Campbell Aevnue, Revelstoke; and one on Pearson and Wynn streets.

7836—August 20—Authorizing the City of Revelstoke, B.C., to lay trunk sewer pipe across right of way of C.P.R., at Revelstoke.

7837 and 7838—August 20—Authorizing the City of Brantford to lay storm sewer under track of G.T.R., on Gray street, on Chatham street.

7839—August 20—Apthorizing the City of Brantford to lay sewer under track of the Toronto, Hamilton and Buffalo Railway Co., at Oxford street.

7840—August 17—Authorizing the Woodstock Water and Light System to erect its light and power wires across the track of the G.T.R. at Butler street, Woodstock, Ont.

7841—August 20—Authorizing the City of Toronto to construct and maintain steel drain pipe, fifteen inches in diameter, on the girders of the bridge carrying the rails of the G.T.R. at Lansdowne Avenue.

7842—August 19—Directing the C.P.R. to permit the Municipality of the Township of Laird, District of Algoma, to install a telephone instrument in the station at the Village of Echo Bay.

7843—August 17—Authorizing the C.P.R. to construct its railway across nine highways in the Province of Saskatchewan.

7844—August 18—Authorizing the Canadian Northern Railway to cross the lines and tracks of the Wolseley-Reston Branch of the C.P.R., in the northeast quarter or Section 18, Township 10, Range 13, West Principal Meridian, Sask

7845—August 19—Authorizing the C.P.R. to construct branch line or spur to the premises of D. Maxwell & Sons, St. Mary's, Ont.

7846 and 7847—August 19—Authorizing the Manitoba Government Telephones to erect wires across tracks of Canadian Northern Railway, at public crossing three-quarters of a mile north of Rounthwaite, Man.: and at public crossing at Elphinstone, Man.

7848—August 19—Authorizing the Allan Rural Telephone Company, Ltd., to erect its wires across the track of the G.T.R., between sections 2 and 3, in Township 34, Range 1, West Third Meridian, Province of Saskatchewan.

7849—August 17—Authorizing the Woodstock Water and Light System to erect its wires across the tracks of G.T.R., at Burtch street, Woodstock, Ont.

# ENGINEER'S LIBRARY

## A MONTHLY INDEX.

Commencing with this issue we are opening a new department in this section of our paper— a Monthly Index.

This month the index is very incomplete—but from month to month it will grow. We do not purpose indexing articles that appear in our own journal, but purpose giving a list of the more important articles appearing in the leading technical publications of Canada and the United States. This section will be of interest from month to month, and will be of great value to those engineers who find it necessary on short notice to gather literature on particular subjects.

For the present we will confine our list of subjects to a few of the more important ones, increasing the size of the index as the section becomes more popular.

### THE CANADIAN ENGINEER'S MONTHLY INDEX OF CIVIL ENGINEERING LITERATURE.

The purpose of this monthly index is: To inform engineers and contractors of the literature published on those subjects in which they are especially interested, the character of the article and the journal in which it appeared. **We do not index in this section articles that appear in The Canadian Engineer.**

Periodicals containing articles indexed, should be ordered direct from the publishers.

### LIST OF PERIODICALS INDEXED.

**Canadian Society of Civil Engineers Proceedings.**—(Can. Soc. C. E. Proc.), Montreal, Can., m., 4 x 7 in., 50 cents.

**Canadian Cement and Concrete Review.**—(Can. Cem. and Con. Rev.), Toronto, Ont., m., 9 x 14, 15 cents.

**Contractor.**—(Contr.), Chicago, Ill., bi.-w.; 7 x 10 in., 20 cents.

**Engineering—Contracting.**—(Eng.-Cont.) Chicago, Ill., w.; 9 x 12 in., 10 cents.

**Engineering News.**—(Eng. News), New York, N.Y., w.; 10 x 14 in., 15 cents.

**Engineering Magazine.**—(Eng. Mag.), New York, N.Y., 7 x 10 in., 25 cents.

**Machinery.**—(Mach.), New York, N.Y., m., 7 x 11 in., 20 cents.

**Municipal Journal and Engineer.**—(Mun. Jl. and Eng.), w., New York, N.Y., 9 x 12, 10 cents.

**Municipal Engineering Magazine.**—(Mun. Eng. Mag.), Indianapolis, Ill., m., 7 x 10 in., 25 cents.

**Power and Engineer.**—(Pow. and Eng.), New York, N.Y., w.; 9 x 12 in., 5 cents.

**Railway Age Gazette.**—(R. R. Age Gaz.), New York, w.; 8 x 11 in., 15 cents.

**Surveyor, The.**—(Sur.), London, Eng., w.; 6 x 11, 10 cents.

## BRIDGES, CULVERTS AND FOUNDATIONS.

**Cost of Several Culverts in Missouri.**—Con. Sept. 1st, 1909, pp. 1.

This article gives the cost per cubic yard for material, labor, etc.

**Monroe St. Bridge, Spokane.**—Eng. News. Sept. 2nd, 1909. pp. 2.

Description of a concrete bridge with a 281-ft. arch. Dimentioned illustrations.

**Bridges of New York City.**—Eng. Mag., Sept., 1909, pp. 16.

An illustrated article by T. Kennard Thomson, Consulting Engineer of New York.

## MISCELLANEOUS.

**Calculation of Pillar Cranes.**—Mach., Sept., 1909, pp. 3.

An article by Charles A. Schranz, in which he deals with the stresses in the boom, tie-bars, tie-rods and on the foundation.

**Design of Members Subjected to Combined Stresses.**—Eng. News. Sept. 2, 1909, pp. 2.

Article by E. L. Hancock, Assistant Professor of Applied Mechanics, Purdue University.

## SEWERS, SEWAGE AND WATERWORKS.

**Water Purification Plant of Toledo.**—Mun. Jl. and Eng., Sept. 1st, 1909, pp. 8.

A description of a filtration method. Sanitary significance of bacteria in the air of drains and sewers.—Eng. News, Sept. 2nd, 1909, pp. 3.

**The New Pittsburg Filters.**—Mun. Eng. Mag., Sept., 1909, pp. 6.

A description of the largest individual sand filtration plant in the United States.

## RAILWAYS.

**Train Resistance.**—R. R. Age Gaz., Sept. 3, 1909, pp. 2.

The second division of a series by F. J. Cole, Consulting Engineer for the American Locomotive Works. Illustrated.

**Uniform Cassification.**—R. R. Age Gaz., Sept. 3, 1909, pp. 2.

The first of a series by Samuel O. Dunn.

**Electric Power or Steam Railways.**—Eng. Mag., Sept., 1909, pp. 13.

## CONCRETE AND REINFORCED CONCRETE.

**Placing Concrete on Unusual Bridge Structures.**—Con. Sept. 1st, 1909, pp. 2.

**Reinforced-Concrete Dome at Los Angeles, Cal.**—Eng. News, Sept. 2, 1909, pp. 2. Illustrated.

**Sidewalk and Curb Design and Construction.**—Mun. Eng. Mag., Sept., 1909, pp. 8.

Illustrated with dimentioned drawings.

## BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

**Azimuth,** by George L. Hosmer; published by John Wiley & Sons, New York. Size, 4½ × 7; 73 pages; bound in pocket-book form. Price, $1.

The author of this little work is George L. Hosmer, Assistant Professor of Civil Engineering, Massachusetts Institute of Technology. The object of the work, as stated in the preface, is to serve as a handbook for practical use in the field, rather than as a text-book for instruction in theory; so that the book contains very little theory and no derivations of formulae, while explicit directions are given for taking observations with the engineer's transit, together with forms of record and illustrative examples.

The methods treated are the following:

By altitudes of the sun.

By observations of Polaris, using altitudes of other circumpolar stars to determine its hour angle.

By observations of Polaris and other stars on the same vertical circle.

The more accurate method by observing Polaris at any hour angle.

By Polaris at elongation.

By equal altitudes of a star or the sun. Some of the simpler methods of determining latitude and time are also introduced incidentally.

The application of the second method above indicated is facilitated by the use of extension tables which are appended; and in addition to these are given several other tables required in the reduction of the observations; such as tables of refraction; logarithms of numbers; logarithmetic sins and versed sins; a table giving the value of the sun's declination from 1909-1912 inclusive, etc. Tables are also given for reducing stadia measurements.

The problem of determining azimuth is the most important one in Practical Astronomy from the standpoint of the engineers, who may be called upon at any time to determine the direction of the meridian; and Professor Hosmer's little book may be heartily recommended to those who have not the time to master the theory of the subject as laid down in our standard text-books, but who wish to have at hand the practice set forth in a concise form.

L. B. S.

**Engineering Wonders of the World,** Part 5.—C.P.R. Number, edited by Archibald Williams; published by Thomas Nelson & Sons, London, England, and New York, U.S.A., with map and twenty-eight illustrations. Price, 15 cents. Specially written by J. M. Gibbon and Stephen Pardoe, of the Canadian Pacific Railway Company.

Popular in style, but interesting alike, to the engineer and the general reader, is the story of the Canadian Pacific Railway—one of the engineering wonders of the world. If the selling price of the publication were increased fourfold, it would still merit the same demand. From a cursory glance at the article, some idea of its scope and value may be formed. An elaborate specimen of color printing is offered by the frontispiece which depicts, in vivid tints, a snow shed typical of those built over the tracks as they wend their way across the steep slopes of the Rockies, while the article itself is replete with scenes and views profusely illustrating some of the more interesting incidents and landmarks connected with the history of the road.

At the head of the article, which is cleverly written by men on the inside—one of them actually helping to lay the track—appears a drawing of the new viaduct at Lethbridge, the largest structure of its kind in the world.

In 1871, British Columbia entered the federation of the provinces of Canada—on conditions, one being that a railway should be built across the continent to give her more direct access to Eastern Canada and the Atlantic. It is largely to this agreement that the Canadian Pacific owes its origin.

Following the introduction, the authors briefly outline some of the difficulties, including political differences, which had to be faced.

Some information is then given regarding the financing of the project, and the men at the helm. This is immediately followed by an account of Sir Sanford Fleming's exploratory expedition across the prairies and the Rockies, from Nepigon to Victoria, via Fort Garry, (now Winnipeg), Fort Edmonton, the Yellowhead Pass, and the Fraser River, a trip that now occupies three days taking him and his party as many months. Interesting reference, in which Sir Sanford Fleming's observations apropos at the opening of the Lake Superior section of the line are quoted at some length, constitutes another portion of the story. This includes notes worthy of study upon the obstacles that had to be overcome and the engineering feats which the men in charge of the construction work accomplished.

Figures relative to the time and cost of construction, paragraphs telling in detail how the prairie section was built, a page describing camp life, a survey story, some amusing anecdotes well told, and numerous illustrations of a high order form what is probably the most attractive part of the volume. And yet, thrilling from start to finish is that portion which is devoted to a description of the line from the "Great Divide," at the summit of Kicking Horse Pass, to Vancouver, now one of the first five cities on the route by which travels the trade of the world—"the keystone of the world's commercial arch."

To read of the mountain section of the road is the next best thing to seeing it. The story recalls fairy tales of flying trips in a magic carpet and is extremely suggestive of aerial navigation dreams and travels by the latest mode, whose joys are fondly anticipated by all. Every incident of importance, from the location of the line to the driving of the last spike, at Craigellachie, by Lord Strathcona, is chronicled in a style which is pleasing. Events of national importance are referred to.

The C.P.R. has done much for Canada. The C.P.R. has made the West. It has made a nation. And thus, as the authors remind us, it has forged one of the strongest links in the chain which now binds together a mighty Empire.

Wm. M.

**Northland Exploration.**—There has just been issued from the Railway Lands Branch of the Department of the Interior, by order of the Hon. Frank Oliver, Minister, a report on Northland Exploration under his Department during the season of 1908, covering that portion of Saskatchewan north of Prince Albert as far as the Churchill River, extending from Montreal Lake and Lac la Ronge, on the east, to Green Lake, and connecting waters as far north as Portage la Loche on the west. The report was prepared by Frank J. P. Crean, C.E., and copies can be obtained free on application to the Superintendent, Railway Lands Branch, Department of the Interior, Ottawa.

**Tables of the Properties of Steam,** and other vapours and Temperature-Entropy Tables, by Cecil H. Peabody. Published by John Wiley & Sons, New York, 133 pages. Price, $1 net.

This is the eighth edition of the author's well-known Steam Tables, published in 1888, and was thoroughly revised in 1907, introducing information from the important experimental investigations by Callendar, Barnes, Knoblanch, Thomas and others, and adding a Temperature Entropy Table. The properties of saturated and superheated steam have recently been determined by methods susceptible of certainty and precision, so that computations based upon them show satisfactory concordance. This information has been used and the tables entirely recomputed The introduction contains original experimental data and the derivation of formulae used in computing tables. The Temperature-Entropy Tables are constructed for both saturated and superheated steam, and facilitate the solution of adiabatic problems which are given prominence by the development of the steam turbine.

**A Brief Course in Elementary Dynamics for Students of Engineering.**—By Erwin S. Ferry. Published by MacMillan Company, New York, pages 182, illustrations and diagrams, 121. Price, $1.25 net.

A text book for students, presenting a clear and consistent development of the laws of dynamics, discussing statics or the laws of equilibrium, friction between solids, kinetics, or the laws of connecting force and motion, statics of fluids, motion of bodies under variable forces, etc., with numerous problems collected by the author over a number of years, which are made more practical than usual. The book is well written and will prove of value to the engineering student. The principles and fundamental laws are thoroughly taken up without discussing a vast range of different phenomena, and the illustrations are chosen from familiar subjects.—F. A. G.

**The Economy Factor in Steam Power Plants.**—By Geo. W. Hawkens, published by Hill Publishing Company, 505 Pearl Street, New York; pp. 133, with 50 diagrams. Price, $3 net.

The material embodied in this book covers a most valuable lot of data and diagrams bearing on the efficiency of apparatus and economy of steam power plants. It is divided into four parts:—Part I. treating of the individual pieces of apparatus forming a steam power plant; discussing briefly their economy and the conditions which tend to vary it. A number of valuable curves on boiler and engine economy are given.

Part II. deals with the factors of evaporation discussing feed water temperatures, and the comparative efficiencies of auxiliary apparatus.

In Part III., under complete plant economy the authors discuss three types of plants, viz.; (1) non-condensing, (2) surface condensing, (3) jet condensing, developing formulae in each case for obtaining the economy of the plant, with tables and graphic representation of these formulae. Examples of their use are appended.

Part IV. contains a discussion of the economy of a plant working under variable load, with numerous load curves and diagrams, illustrating deduced formulae by examples.

The book forms a most valuable treatise on plant economy, illustrating the importance of the fuel economy factor in the design of the power-station. It will prove a most useful book to the designing engineer and the student, containing specific information which cannot be obtained in such complete form elsewhere.

**Electric Smelting of Iron Ores.**—As a sequence to the reports on Electric Smelting of Iron Ores, published in 1904, 1906, and 1907, the Mines Branch of the Department of Mines of Canada has just issued the results of "An Investigation of an Electric Shaft Furnace" in operation at Domnarfvet, Sweden. The investigation was made by Dr. Eugene Haanel, in December, 1908, on the invitation of the inventors, and the results given represent the latest developments of the electric smelting of iron ores.

The report contains 38 pages and is divided into four parts.—Part 1 deals with the Domnarfvet furnace, the trial runs witnessed by the writer of the report and the comparative costs of production of pig-iron by the furnace. The other three parts which are more of the nature of appendices, describe:—(1) A new electric furnace for the manufacture of steel, (2) the manufacture of electrodes, (3) methods of manufacturing wood-charcoal, this material being used to supply the carbon which enters into the composition of pig-iron manufactured by electric smelting.

Three full page plates, from photographs, and numerous drawings, illustrate clearly the descriptive matter of the book, which, taken in conjunction with the reports previously published by the Mines Branch on the subject of electric smelting, brings up to date the literature on the electro-metallurgy of iron.

The "Report on the Investigation of an Electric Shaft Furnace" at Domnarfvet, Sweden, may be obtained on application to Dr. Eugene Haanel, Director of Mines, Department of Mines of Canada, Ottawa.

## PUBLICATIONS RECEIVED.

**Hydroelectric Developments and Engineering.**—By Frank Koester. Assoc. Mem. Am. Inst. E.E., 454 pp., 500 illustrations, price, $5. D. Van Nostrand Company, publishers, 23 Murray, and 27 Warren Streets, New York, U.S.A.

**Electric Railway Power Stations.**—By Calvin F. Twingle, M.E., 720 pp., 6 x 9, cloth, $2. Frederick J. Drake & Company, publishers, Chicago, Ill.

**The Fire-Resistive Properties of Various Building Materials.**—By Richard L. Humphrey, 100 pp., 6 x 9. Bulletin 370, Dept. of the Interior, N.S., Geological Survey, Technologic Branch, Washington, D.C.

**Simplified Methods of Calculating Reinforced Concrete Beams.** — By W. Noble Twelvetrees, M.I. Mech. E. A.M.I.E.E., M.R.S.I., 25 pp., pocket size; 15 cents. Whittaker & Company, publishers, 2 White Hart St., Paternoster Square, London, E.C., and 64-66 Fifth Avenue, New York, U.S.A.

**Canadian Annual Review of Public Affairs, 1908.**—By J. Castell Hopkins, 669 pp., 6 x 9, cloth, $5. (?)—Annual Review Publishing Company, 2 College Street, Toronto.

**Railroad Promotion and Capitalization in the United States.**—By Frederick A. Cleveland, Ph.D., and Fred. Wilbur Powell, A.M., 365 pages, 6 x 9, cloth. Longmans, Green & Company, 91 and 93 Fifth Avenue, New York, and London, England.

**Practical Armature and Magnet Winding.**—By Horstmann and Tousley, 250 pages, pocket size. Morocco leather binding, price, $1.50. Frederick J. Drake & Company, publishers, Chicago, Ill.

**Wrought-Iron Cement-Lined Water Pipe.**—By Leonard Metcalf, civil engineer, Boston, Mass., 90 pp., 6 x 9.

**Waterproofing.**—By Myron H. Lewis, C.E., 200 pp., 6 x 9, reprinted from paper read before the municipal engineers of the city of New York. Engineering News, Book Department, 220 Broadway, New York City.

**Tungsten Ores of Canada:** A Report by T. L. Walker, M.A., PhD., containing 60 pages, 6 x 9; Pub. Doc., Mines Branch, Ottawa. Hon. W. Templeman, Minister.

**Journal of the American Society of Engineering-Contractors:**—June 1, 1909, Vol. 1, containing constitution and list of members:—Daniel J. Haner, Secretary, Consulting Engineer, Park Row Building, New York City.

## CATALOGUES.

**Pumps:**—A complete power driven outfit for use of contractors, builders, railroads, or on public works, where it is necessary to raise large quantities of water, or to handle water containing mud, sand, grit, gravel, coal, grain or chips, sewage, or any liquid that will flow, is described in Bulletin No. 500, which the Fuller and Johnson Manufacturing Company, of Madison, Wis., are just distributing. A price list is included.

**Blueprints:**—Several kinds of blueprint paper and a price list are dealt with by the Keuffel & Esser Company, Hoboken, N.J., in a pamphlet which has just been prepared for them. The directions given for obtaining the best results will undoubtedly be appreciated by men who have to do with blueprints and blueprinting.

**Heating and Ventilating:**—The best obtainable illustrations and descriptions of the Buffalo Fan System of heating, ventilating, humidifying and drying are given in catalogue 197, just published by The Canadian Buffalo Forge Company, of Montreal, Canada. Heating and ventilating buildings of all kinds is dealt with at some length in the first two sections. Part III. contains interesting matter regarding the apparatus itself, while Part IV. gives reliable data, with tables, on heating and ventilating, which has never before appeared in print. The volume, comprising 144 pages, is replete with valuable information.

**Concrete Blocks:**—A booklet issued by the Dominion Concrete Company, Limited, Kemptville, Ont., contains several illustrations which demonstrate the adaptability of concrete blocks for various kind of buildings. Builders will be interested in the publication, and the publishers will be pleased to send it to those interested, on application.

**Supplies:**—The Brydges Engineering & Supply Company, of Winnipeg, have issued a very handy catalogue cover, by which separate sheets of any line desired can be sent out to those desiring same. The device saves the expense of supplying anyone with the large amount of material in the ordinary catalogue, the majority of which they are not interested in.

**Riveting Machines** for structural, bridge and railroad work, boiler, tank and stack construction, which are manufactured by John F. Allen, 370-372 Gerrard Avenue, New York City, are dealt with in an interesting fashion by this old-established manufacturer. Copies of this pamphlet will be cheerfully sent upon application.

**Valves:**—Canada's highest grade valve, the "Standard Crown," is illustrated and described by the Standard Engineering Company, of Toronto, in a handy booklet, which also contains a price list that is useful for reference purposes.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING — CONTRACTORS.—President, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION. — President, Thomas Southworth· Secretary-Treasurer, King Radiator Co., Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto: Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H Warder, Secretary.

## COMING MEETINGS.

**Nova Scotia Society of Engineers:** September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Nova Scotia.**

HALIFAX.—Tenders will be received up to Wednesday, September 15th, for electric fittings for the Technical College. Herbert E. Gates, architect; Christopher P. Chisholm, Com. Public Works and Mines.

**Quebec.**

ST. JOHNS—Tenders for Customs fittings, St. Johns, P.Q., will be received until Wednesday, September 15. Plans to be seen on application to Mr. Leon Forant, caretaker, Public Building, St. John, P.Q., and at the Department of Public Works, Ottawa. Napoleonn Tessier, secretary, Ottawa.

MONTREAL.—Tenders for laying concrete at the La Fontaine Park Pond will be received until September 13, by L. O. David, city clerk.

QUEBEC.—Tenders will be received by Rene P. Lemay, architect, 21 d'Aiguillon Street, up to September 20th, for the construction of the Quebec Technical School. Antonin Galipeault, secretary-treasurer.

ST JOHNS.—Tenders for Customs fittings will be received until Wednesday, September 15. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

THREE RIVERS.—Tenders will be received until Thursday, Sept. 16th, for supplying and installing pressure filters with a capacity of two million gallons per 24 hours. L. T. Desaulniers, Secretary-treasurer.

THREE RIVERS.—Tenders will be received up to the 16th Sept., for the construction of a reinforced concrete or iron bridge, of 16 feet wide, on Ste. Marguerite Road, to be finished before the 16th Nov. Each tenderer must furnish his plans and specifications. L. T. Desaulniers, secretary-treasurer. City Hall, Three Rivers, 28th Aug., 1909.

**Ontario.**

BARRIE.—Tenders will be received until September 13 for material for sewers. C. H. & P. H. Mitchell, Toronto, engineers; E. Donnell, clerk. (Advertised in the Canadian Engineer.)

BARRIE.—Tenders will be received until September 13 for outfall works in connection with sewage disposal. C. H. & P. H. Mitchell, Toronto, engineers; E. Donnell, clerk. (Advertised in the Canadian Engineer.)

LEAMINGTON.—Tenders for electric wiring and fittings for the Public Building, will be received until Thursday, September 16. G. Roach, Clerk of Works, Leamington; T. A. Hastings, Clerk of Works, Customs House, Toronto. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received until 28th September, 1909, for the construction of steel superstructures and floor systems for bridges at the points named below:

**District "A."**

| Mile | Bridge | Date of Completion |
|---|---|---|
| 82.0 | Cains River | December 1, 1909 |
| 124.5 | South-West Maramichi, N.B. | March 15, 1910 |
| 133.0 | South-West Maramichi, N.B. | March 15, 1910 |
| 134.07 | Juniper Brook | April 1, 1910 |
| 1.42.0 | Odell Brook | April 1, 1910 |

**District "D."**

| | | |
|---|---|---|
| 62.25 | Circle River | July 1, 1910 |
| 62.5 | Low Brush River | June 1, 1910 |
| 99.0 | Brule Creek | April 1, 1910 |
| 109.29 | Frederichouse River | April 1, 1910 |
| 113.48 | Buskegow River | April 15, 1910 |
| 123.5 | Driftwood River | May 1, 1910 |
| 135.0 | Mattagama River | June 1, 1910 |

Plans and profiles may be seen at the office of the Chief Engineer at Ottawa. P. E. Ryan, secretary.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received up till Sept. 14th, for all the various trades required in the erection and completion of an 8-storey fireproof building on the south-east corner of King and Jordan Streets, Toronto, for the Standard Bank. Darling & Pearson, 2 Leader Lane, Toronto, architects.

TORONTO.—Tenders will be received up to noon on Tuesday, September 21, for an underground public lavatory, proposed to be constructed on Broadview Avenue, near Queen Street. Joseph Oliver **(Mayor)**, Chairman of Board of Control.

WALLACETOWN.—Tenders will be received up till Monday, September 13, for the erection of two schoolhouses in S.S. No. 14, Dunwich. Basements and walls to be of concrete. D. B. McPherson, secretary.

**Manitoba.**

WINNIPEG.—Tenders will be received up to September 14, 1909, for the excavation and back filling of a pipe line from the Red River to the locomotive shops, etc., east of St. Boniface, Man., on the line of the Transcontinental Railway, to be completed by December 31, 1909. Full information with respect to the work may be obtained at the office of the Chief Engineer at Ottawa, Ont., and the office of the District Engineer at St. Boniface, Man. P. E. Ryan, secretary, Commissioners of the Transcontinental Railway, Ottawa.

WINNIPEG.—Tenders will be received up to Friday, 3rd September, for 2,700 lineal feet wire fencing for Brookside Cemetery, and 820 lineal feet iron fencing for William Whyte Park. J. H. Blackwood, secretary, Public Parks Board Office.

WINNIPEG.—Tenders for the following supplies for the fire department will be received up to Tuesday, September 14th, 2,000 feet of 2½ inch cotton rubber lined fire hose, complete with couplings. 15 fire alarm boxes, non-interfering and weight movement type, and complete with key box on door, piping, rain cap, keys, etc. 127 pairs felt-lined rubber boots. 274 pairs woolen mitts. M. Peterson, secretary, Board of Control.

**Saskatchewan.**

ESTEVAN.—Tenders for electric wiring and fittings will be received until Tuesday, September 21. Mr. G. T. Falkner, Clerk of Works, Estevan; Napoleon Tessier, secretary, Department of Public Works, Ottawa.

## CONTRACTS AWARDED.

**Quebec.**

QUEBEC.—Mr. Ign. Bilodeau, who secured the contract for laying water mains at 67 cents a foot, recently asked for $1.10 on the ground that he was losing money. The contract has been cancelled, and the city will do the work by day labor.

**Ontario.**

LONDON.—E. Leonard & Sons of this city have been awarded contracts amounting to about $2,500 for twelve oil tanks for the six transformer stations of the Hydro-Electric

line at London, St. Thomas, St. Mary's, Stratford, Woodstock and Paris.

ST. THOMAS.—A contract for the construction of a concrete culvert over Mill Creek on the L. & P.S. Gravel road was awarded to Scoyne & Ramey, of Talbotville, for $810. The other tenders were G. A. Ponsford, $899; H. F. Woodry, $1,185, and Powell & Gunning, $1,184.

WATERLOO.—The following tenders were received for sewer construction:

| | G. Moogk per foot | P. Bergman per foot |
|---|---|---|
| Foundry Street | $1.05 | $1.20 |
| Park Avenue | 1.05 | 1.20 |
| Victoria Street | 1.05 | 1.25 |

The lowest were accepted

**Manitoba.**

WINNIPEG.—Messrs. E. R. Watts & Son have just supplied one of their 8-foot telescopes to the Astronomical Department of the University of Manitoba. E. R. Watts & Son, Winnipeg branch report that they have had a splendid season, especially in their smaller makes of instrument, which they state they have not been able to get out fast enough.

WINNIPEG.—The City of Winnipeg have awarded the contracts for electrical apparatus in connection with the power plant at Point du Bois, which shows a saving to the city of approximately $157,000 lower than the best tenders recommended in October 1907. The total of the figures of contracts awarded is approximately $425,000, and the successful tenderers are as follows:—Turbines: Jens, Orten. Boving & Company, London, Eng., $97.150; includes $11,000 for erection. Generators and Exciters: Vickers, Sons & Maxim, Ltd., Sheffield, Eng., $93,080; this price includes erection. Transformers, Switching and Protective Apparatus: Canadian Westinghouse Company, Ltd., Hamilton, Ont., $150,800; including spare parts. Light, Heat & Power System, Generating Station: Canadian General Electric Company, Toronto, Ont., $11,600. Travelling Cranes: Canadian Fairbanks Company, Ltd., Winnipeg, Man. (Niles-Bement-Pond Company), $14,900; including estimated cost of erection. Auxiliary Apparatus—Canadian Apparatus: Canada Foundry Company, Ltd., Toronto, $27.520; Canadian Fairbanks Company, Ltd., Winnipeg, Man., $6,901; allowance for contingencies and spare parts, say $23,049.

**British Columbia.**

NAKUSP.—A logging contract of considerable importance to the town has been entered into between Lindsley Bros. Company, of Spokane, and A. Criel & Hartling, of Nakusp, whereby the latter will take off all the timber on 1,200 acres of land on the lake shore south of the town.

NEW WESTMINSTER.—The City Council have accepted a tender of $218,527 for the steel pipe needed between Coquitlam Lake and Queen Park Reservoir, 74,600 feet of riveted pipe for the new 24-inch main, letting the contract to the lowest tenderer, J. C. McDonald, of Grand Forks. There was a lengthy discussion as to whether the tender for the whole work, 12 and 24-inch pipe, should not have been let to one contractor, but ultimately the Council decided to offer the Robertson Godson Company of Vancouver, who had tendered lowest, for the 12-inch pipe. This is the section from Queen's Park to the city boundary on Lulu Island. Their figure was $21,242.

VANCOUVER.—The contract for material for a 11,000-ton floating pontoon dry-dock, which is to be built on Burrard Inlet, has been awarded to Swan & Hunter, Wallsend-on-Tyne, England.

VICTORIA.—The City of Victoria recently purchased from the Waterous Engine Works Company, of Brantford, a $5,000 fire engine, which is proving entirely satisfactory.

## SEWERAGE AND WATERWORKS.

**Quebec.**

LORETTE.—The installation of waterworks here has been decided on by a number of residents, who have formed a company. Mr. Louis Narcisse Leclerc a physican, is one of the provisional directors.

MONTREAL.—Messrs. Ouimet and Lesage will shortly proceed to construct a part of the sewerage systems for the towns of Berthier and Lachute.

MONTREAL.—The town of Limilou has instructed Messrs. Ouimet and Lesage to proceed to construct their new concrete reservoir and to carry out certain improvements to their aqueduct.

**Ontario.**

PERTH.—The City Council are constructing a sewer from the House of Industry across the Matheson farm to connect with the sewerage system of the town. The town is to have the privilege at any time of connecting with the portion necessary for the county to construct. This is the method necessary to solve the question of the pollution of the town's water supply, which was taken from a point in too close proximity to the place where the House of Industry sewage formerly entered the river.

TORONTO.—A system of drainage for the district between Sunnyside avenue and High Park, has been recommended by City Engineer Rust, at an estimated cost of $62,000. It will be necessary to have a pumping plant to lift the sewage up into the King street sewer.

**British Columbia.**

VICTORIA.—A special meeting was held recently to deal with the question of additional water supply, in view of the recent defeat of the by-law introduced for the expropriation of the Esquimalt Waterworks Company. Expert advice will be secured regarding Sooke Lake.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—The Angus shops of the C.P.R. have just turned out the last of thirteen 95-ton freight engines for the Western lines. Eight locomotives were built at these shops during August.

MONTREAL.—That telephones for train despatching will soon be general all over the C.P.R. system was the announcement made recently by Mr. James Kent, the manager of telegraphs, Canadian Pacific Railway, on his return from his annual tour of inspection of the company's telegraph system in Western Canada. As is known, the telephone has been in use for train despatching on the C.P.R. between Montreal and Newport for over a year, and while in the West Mr. Kent superintended the opening of three new telephone divisions, namely, between Swift Current and Medicine Hat, a hundred and thirty miles; between Winnipeg and Brandon, about the same distance, and between White River and Fort William.

**Ontario.**

BERLIN.—The G.T.R. will erect a steel bridge here.

LONDON.—On October 20th next, at 12.30, at the offices of the London & Western Trusts Company, 382 Richmond Street, there will be offered for sale the South-Western Traction Company—a railway about 28 miles in length, connecting London with Port Stanley and passing St. Thomas. Thomson, Tilley & Johnson, 59 Yonge Street, Toronto, solicitors.

PORT COBALT.—All grading has been done on the roadbed of the Nipissing Electric Railway, contracts have been let for the construction, and the rails will be on the ground by the first of next week. It is the intention to at once lay six miles of rails. This will be done by the first of November. The line will first be built from Cobalt right to Haileybury, and will run half way down to the lake at Port Cobalt along Lakeview Avenue.

TORONTO.—The repair shops of the C.N.R. will probably be located in the Don Valley, Toronto, when connections are made with the lines from the East and the West.

**Manitoba.**

WINNIPEG.—The C.P.R. will extend their line into the Peace River country, building north from Edmonton.

WINNIPEG.—Commencing this week the tri-weekly passenger trains over the Grand Trunk Pacific Railway west, which have hitherto run only to Scott, Sask., will go through to Wainwright, Alta., 100 miles farther west. The regular passenger service is now within 115 miles of Edmonton, and it is thought that through trains from Winnipeg to the Alberta capital will be in operation next month.

WINNIPEG.—There still remain forty miles of the N.T.R. upon which steel must be laid to link up this city with the head of the lakes over the new system, and the road will be enabled to take its share of the crop to the lakefront. This will take the contractors about five weeks to complete, as they are handicapped by lack of sufficient labor. The new steel bridge over the Wabigoon, near Dryden, has been holding up work, but this is now completed and track-laying can proceed rapidly.

**Alberta.**

EDMONTON.—Wetaskiwin will shortly be connected to Winnipeg and the east by a short line on the C.P.R. All that remains to be done is the completion of 75 miles between Hardisty and Macklin. The grading is already completed and about two and a half miles of steel is being laid per day. This distance should be completed and trains runing over the line by the first of November. This is the first time in the history of C.P.R. building that 85-pound steel rails are being used. When the steel-laying on the C.P.R. is finished the service between this place and Calgary will be quicker by five hours.

**British Columbia.**

FERNIE.—The C.P.R. is enlarging its yards here.

NEW WESTMINSTER.—Work of constructing the first section of the new Chilliwack line of the British Columbia Electric Railway Company is progressing favorably. Large quantities of steel and track spikes are being taken out to the scene of operations each day from the stock of the British Columbia Electric Railway wharf in this city. One of the newly purchased locomotives with a string of flat cars, attends to this part of the work, the other being attached to the track laying machine, which is working satisfactorily. The rails are now strung for five miles from the Westminster Bridge or about half-way to Cloverdale, but the construction is considerably delayed by lack of men.

PRINCE RUPERT.—The extension of the city yards of the G.T.P. will be built immediately. The grading of two miles or so will be finished by spring. This track will be for the convenience of the Government wharf and the owners of the waterfront leases.

VANCOUVER. — Engineering parties representing the Canadian Northern and the Grand Trunk Pacific Railways are engaged in a neck-and-neck race to locate their respective routes in the vicinity of the summit between North Thompson River and the south fork of the Fraser River. Conditions for securing a minimum grade were found to be excellent. The elevation at the summit is only 2,886 feet. Canadian Northern officials report the advantage thus far with their parties.

VANCOUVER.—Mr. Collingwood Schreiber, consulting engineer of the Dominion Government and consulting engineer of the National Transcontinental Railway, was in Vancouver this week on his way north to Prince Rupert to meet there Mr. Charles M. Hays and Sir Charles Rivers Wilson and made an emphatic pronouncement in regard to the labor question. He was quite animated in stating that British Columbia not only wanted the G.T.P., but needed it badly, yet it imposed the condition that only white labor should be employed. Consequently, where 3,000 men are now employed, 10,000 could be given employment, and the construction is proceeding slowly. He suggested that some provision be made whereby anyone could be employed, and if foreigners were required that they come into the country only under agreement to get out again after they were not required by the railway contractors. Mr. B. B. Kelliher, chief engineer of the G.T.P., accompanied Mr. Schreiber, and added that every white man that could be got was put on the work, and if he supported Mr. Schreiber's suggestion it was not because he wanted foreigners in opposition to the white men. He told the Canadian Engineer that he preferred the white man every time because of his better work, and if any other color was employed lower wages would be given. It was simply because labor was needed to get the line ahead that they wanted any kind of men. As it was, it meant that the money in the completed line would be tied up, without any earning power, until the remainder of the line was completed.

**England.**

LONDON.—The British Columbia Electric Railway Company is issuing $2,500,000 new capital for the purpose of making extensive improvements and of building a new terminal in Vancouver.

**Foreign.**

PORT HURON, Mich.—The big addition to Block 1 shops of the G. T. R., which will comprise 10,000 feet of floor space, will be started in the near future. When the new addition to the shops is completed the force at the big institution will be increased 50 per cent.

## LIGHT, HEAT, AND POWER.

**Quebec.**

FARNHAM.—The vote on the electric light by-law, providing for the borrowing of $21,000, announced for Monday, did not take place. Mr. Poulin, who owns the present plant, but who had asked $14,000 for his property, made a new proposal to sell for $8,500, and as a consequence the by-law was withdrawn and the purchase of the Poulin property at $8,500 sanctioned.

MONTREAL.—The Montreal Light, Heat & Power Company has sent to the city its street lighting account for July, amounting to $12,837, plus five per cent., and giving notice that action will be at once taken to recover this amount, together with that due to July 30, namely $82,256.

**Ontario.**

TORONTO.—Work has been commenced in connection with the establishment of the city's new electrical distribution plant for which Golden & Lansing, of Troy, N.J., secured the contract. The laying of conduits is to cost $65,800.

TORONTO.—Rapid progress is being made by the McGuigan Construction Co. with the work of erecting the steel towers for the transmission line between Glanford and Ancaster townships, where a line of steel towers five miles long greets the eye. So far eighty-five towers have been put in place and the work is proceeding at the rate of eight towers per day. The completed system will involve the longest transmission line in the world. With branches it will be 297 miles in length, and will carry a current of 110,000 volts.

**Manitoba.**

BRANDON.—The Maple Leaf Flour Mills are undergoing extensive alterations. A producer gas engine of 375 horse-power is being installed to supply power for the large mill. This large gas engine, which is horizontal, is 33 feet in length, weighs 95,000 pounds, will cost $20,000 to install, and when completed will revolutionize cheap power in Brandon.

## FINANCING PUBLIC WORKS.

**Nova Scotia.**

YARMOUTH.—The town council is considering by-laws to borrow $6,000 to build an engine house and not more than $80,000 for waterworks improvements. Mr. Hiram Gondey is town clerk.

**Quebec.**

FARNHAM.—The vote on electric light by-law which was to raise $21,000, did not take place. An agreement has been made with the owner of the present plant.

MONTREAL.—The municipality of Point Claire, near Montreal, is borrowing $75,000 to enable their engineers, Messrs. Ouimet and Lesage, to carry out the sewerage and aqueduct system devised for the village.

**Ontario.**

WESTON.—By a vote of 149 to 87, a majority of 62, Weston ratepayers on Saturday voted to expend $57,000 on a waterworks system, the source of the supply being the Humber River. Mr. Willis Chipman, of Toronto is the engineer.

**Manitoba.**

WINNIPEG.—A $600,000 by-law to cover the cost of building three new schools has been passed by the Winnipeg city council.

**British Columbia.**

NANAIMO.—A by-law to raise $60,000 for sewage disposal works has passed its first and second reading here.

NEW WESTMINSTER.—By-laws for street improvements, water-works extensions, etc., amounting to $398,000 were passed by the ratepayers.

VICTORIA.—Mayor Hall has intimated, since the defeat of the Esquimalt Waterworks by-law, that he intends introducing a by-law to raise money to bring water from Sooke Lake.

## CEMENT—CONCRETE.

**Quebec.**

MONTREAL.—A new concrete reservoir will shortly be built for the town of Limilou by Messrs. Ouimet and Lesage, engineers, Montreal.

MONTREAL.—Some concrete work is to be done in connection with the La Fontaine Park pond, and Mr. L. O. David, city clerk, will receive tenders until September 13th.

MONTREAL.—The official announcement was made on Monday that the final negotiations and legal details of the new big cement merger, to be known as the Canada Cement Company, had been closed, and the underwriters within a day or two will be in a position to announce the terms of the public offering of the securities of the company. A leading official of the new company stated it would start out with an annual output of 4,500,000 barrels, or an average of 15,000 barrels a day for every working day in the year.

MONTREAL.—Official announcement was made here on Tuesday of the total capitalization of the new Canadian cement merger and of the terms on which the public offering of the securities of the company will be made. The company will have $8,000,000 of 6 per cent. gold bonds, of which $5,000,000 will be issued at present of the capital stock of $30,000,000. It is intended to issue at present $10,000,000 of the total of $11,000,000 of preferred shares and $12,500,000 of the total of $19,000,000 of common shares, making the amount of both stocks to be issued at present $22,500,000. The Royal Securities Corporation, on behalf of the underwriters, will offer for subscription $5,000,000 of 7 per cent. cumulative preferred shares at $93 per share, the same to carry with them a bonus of one share of common stock for every four shares of preferred stock subscribed for. All applications are to be made through the Royal Trust Company.

**Ontario.**

WALLACETOWN.—Mr. D. D. McPherson, Sec. S. S. No. 14, Dunwich desires tenders for the erection of two concrete schoolhouses.

## MISCELLANEOUS.

**Quebec.**

MONTREAL.—Engineers have been at work since Wednesday last on a survey for a new bridge between this city and St. Lambert. It is said the surveyors have been engaged by the Delaware & Hudson, the N.Y. Central and the Rutland Railways.

MONTREAL. — The Quebec Bridge Commission have decided to call for tenders for types of bridge, cantilever and suspension. The new bridge will be 150 feet above high tide for 600 feet in the centre of the river; it will also be 24 feet wider than the old bridge, which was only 61 feet wide. The centre span will be reduced from 1,800 feet to 1,715 by building a new pier 100 feet farther from the north shore than the present pier. On the south side the present pier will be widened and strengthened, so as to bear the greater weight. Nickel steel will be used in the eye bars and for compression members, and, in brief, the new structure will be made as safe and strong as human ingenuity and skill can make it. It is expected that a start will be made very shortly, as the meeting has removed many of the causes of delay.

**Ontario.**

TORONTO.—At a meeting on September 2nd in the offices of Fetherstonhaugh & Company, a society was formed for the advancement of the Science of Aeronautics. It will be called "The Aeronautic Society of Canada." Mr. F. B. Fetherstonhaugh was chairman and Mr. E. H. Guthrie, secretary.

**Manitoba.**

WINNIPEG.—The Manitoba Bridge & Iron Works have a large amount of work under contract, and there is yet no sign of any decrease in the amount of business for the remainder of the season. Some of the contracts and orders taken recently are:—Large steel smoke stack for the City of Saskatoon; bridge for the Canadian Northern Railway; structural steel and iron for Bank of British North America, Calgary; ornamental iron work for new court house, Brandon; structural steel and iron for new I.O.O.F. Building at Kenora; fire escapes for four new public schools, Winnipeg; structural steel and iron works for court house, Fernie, B.C.; public press building, Winnipeg; Canadian Bank of Commerce, Macleod; Trite-Wood Block, Fernie, B.C., and nine others. One hundred and twenty complete outfits for transmission equipment for grain elevators. The new structural shop built by this company is now completely equipped with modern machinery and appliances, and is in operation night and day.

## PERSONAL.

MR. A. J. NIXON, formerly of the G.T.R., at London, Ont., has been appointed by the Dominion Railway Board head of the newly established department known as the Operating Branch.

PROFESSOR L. A. HERDT, of McGill University and Mr. W. A. Lambe, of the Canadian General Electric Company, of Peterborough, have been appointed by the Dominion Government to be a Board of Examiners to examine candidates for positions as Electrical Inspectors in the Inland Revenue Department.

MR. GILMORE BROWN, C.E., of St. John, has been appointed assistant chief engineer of the Department of Public Works. Mr. Brown's appointment will relieve the present chief engineer, Mr. Lafleur, of some of the constantly-increasing responsibilities and work connected with his office.

MR. B. J. HARPELL has opened an office at 24 Aikins Block, Winnipeg. He is sales agent for Brodesser Elevator Manufacturing Company; Ideal Motors and Generators; Buffalo Forge Fans, Pumps, etc. Mr. Harpell has also taken the Western agency of the Machan & Mayer Electrical Manufacturing Company of Philadelphia, who make a great many lines of electrical specialties.

## MARKET CONDITIONS.

Toronto, September 9th, 1909.

Accounts from Ontario points indicate a moderate movement in the building trade. Hardware and metal dealers find business rather slow, but account for it by the absorption of farmers in harvest matters. In Toronto, neither retail nor wholesale trade is so active as might be supposed from the crowds of people in the streets these four days past. They are mostly Exhibition visitors, and benefit mainly certain classes of trade, and those not staple ones. Later on, an active fall trade may be expected, as the result of generally good crops.

A real revival of business has come in the United States. A good proof of it is the fact that 100,000 unused railway cars have gone into service

# PIG IRON

"Carron" "Clarence"

"Ayresome"

**All good Irons for different purposes.**

**A. C. LESLIE & CO., Limited**
**MONTREAL.**
3


during August. The iron and steel trades have most felt this revival, which tends to stiffen prices of metals generally. The higher market in tin is likely to be continued. Consumption of copper is increasing, and now or later improved quotations may be expected. Of spelter, while the present tendency seems downward, it will hardly remain depressed. Trade in Britain and on the Continent is dull.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand increased within the last fortnight.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—The price continues low, $1.55 per bbl. in car lots, including bags. Demand is slack in Ontario, but some fair lots have been sold for Manitoba and Alberta. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania bard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not 60c.; No. 2 tarred, 62½c.; plain, 56c.

affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady and stocks light.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14 gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15; 10¾, $4.50 per 100 lbs. Fleur de Lis—gauge, $4.50; 26-gauge, $4.25; per 10 lbs. This downward change is the result of dissolution of an agreement between British and U. S. makers. Impossible to say how long it will last.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Talk is still heard of an advance, but nothing definite.

**Lead.**—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—A fair demand is reported for city trade, not so much from the country. Southern pine is the main item here. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.** Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.** An improved request is noted lately, at catalogue prices before quoted.

**Roofing Slate.** Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| ...creasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| ... traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| ... ft. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

...ness steady; price, 73 per cent. off list at factory for car-load ... per cent off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and we quote an advance of ½c., say 31½c. to 32c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 6 to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits.—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Now quite scarce. Tierces, 14¼c.; tub, 14¾c.; pails, 15c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Short cut, $26.50 to $27 per barrel; mess, $25.

**Potatoes.**—Ontario,.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 13¾c. to 14c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.75 per 100 lbs. in barrels; Acadia, $4.65; yellow, $4.35; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 18 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Montreal, September 9th, 1909.

Advices from Cleveland, state that merchant producers of Lake Superior iron ore will advance their prices 50c. per ton, all round, for the season 1910, thereby restoring the 1907 level, which was the highest since 1900. Some think that the announcement will be made early, others thinking that it will be delayed till well on towards next year. The reduction in duty from 40c. to 15c. does not seem to be having the effect of putting prices down in Lake Superior districts, consequently. It is said that there are large importations of ore, in the east, from Spain and Sweden, and some Newfoundland ore, from the Wabana seams, is now being reported. It is thought that fully 1,000,000 tons of ore will be imported into the east next year. The eastern trade is now lost to the Lake Superior producers.

Pig-iron continues to show strength, and an advancing tendency is shown for early delivery. The market for next year is not advancing as rapidly, so that the two markets are approaching each other. A large sale has been made at $18 per ton, delivered, which is better than $15.50 at the furnaces. Foundry iron is very strong, at $15.75, Valley furnaces, for this year, or $16.25 to $16.50 for next year. Bessemer pig is 25c. higher, at $17 per ton, minimum.

In Glasgow, there has been a large turnover in Cleveland warrants. The tone was generally strong, although there was some fluctuating and profit taking. This referred to the week before last, the advices being by mail. Subsequently, cables were received stating that the market had advanced. The movement in hematite is more marked, warrants having risen considerably.

The local market is exceedingly strong, and demand is active. In fact, reports from some of the largest firms in the city are to the effect that last week's sales, for general distribution, formed a new high record, for any similar period, in their recollection. Consumers are now coming rapidly into the market with a view to covering for their fall and winter requirements. Prices on Canadian made metal are stiffening in sympathy with those of other countries, and supplies are limited to two or three furnaces, the others, belonging to the steel companies, consuming all

Approach to Huntley Street Bridge, Rosedale, Toronto, treated with "VULCAN FLUID ASPHALT" under direction of City Engineer, Roadway Department.

GOOD ROADS AT LITTLE COST.

# VULCAN FLUID ASPHALT

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## The British American Oil Co., Limited

Offices 6 KING WEST Refiners - TORONTO, ONT.

"That obtained from The British American Oil Co., I think, is the preferable oil"—Dr. Sheard on Road Oil in "Canadian Engineer," July 16th, 1909.


their own metal in steel making. Enquiry is apparently still keeping up, and it begins to look as though purchasers would have speedily to cover for their requirements in order to get the advantage of present prices. Should ore advance in the United States, it will not be long till pig iron advances also, the result of which advances will be immediately reflected on the English markets, and hence upon Canadian.

A few advances took place during the week in the prices of iron in this market. Other alterations will also be found in the following list, none of the changes being very startling, however:—

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¼-base; tire steel, $1.90 for 1 2 ¼-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus. Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.54; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double tape, 56 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 10-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 10-gauge American, $4.90; 10-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 10-gauge American, $5.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40. Comet, $4.25, Gorbal's Best, $4.25; Apollo, 10¼ oz., $4.15. Add 25c. to above figures for less than case lots; 26-gauge is 10c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¼ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

**Lathe.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft.., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ¼, and $2.10 for ⅜ and thicker; 12-gauge being $2.30; 14-gauge, $2.25; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ⅝-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of ⅝ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, SEPTEMBER 17th, 1909. No. 11

## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

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**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## THE NEW QUEBEC BRIDGE.

Will the new Quebec Bridge be ready for traffic before the completion of the National Transcontinental Railway? It is very doubtful. But the construction of the new bridge is absolutely necessary to the completion of the Transcontinental Railway scheme.

It is fortunate that the Board of Engineers have made such satisfactory progress with their examinations and preliminary plans. We are informed that the centre span will be shortened by one hundred feet, thus leaving six hundred feet one hundred and fifty feet above high water. It is to be eighty-five feet wide, twenty-four feet wider than the old bridge. A new pier will be built on the Quebec side, and the span will be reduced from eighteen hundred to seventeen hundred and fifteen. The south side pier will be enlarged. This will be necessary, since the increased width and heavier members to be employed in the new structure will make it about fifty per cent. heavier than was calculated for the original structure.

The most important decision, however, is that which intimates that the new bridge may be a suspension one. Tenders will be called for both the cantilever and suspension type, and the cost and time of erection will have some considerable influence on the design to be adopted.

Another important announcement that has been made is in reference to the use of nickel steel. In the Canadian Engineer, Vol. XVII., page 83, Mr. R. E. Chadwick summarizes Dr. Waddell's paper on "Nickel Steel Bridges." In this paper particular stress was placed upon the use of nickel in bridges with such large spans as the Quebec Bridge. The new bridge will have nickel steel members. It is said the eye-bars and compression members are to be of this material.

It is some satisfaction to know that the Board of Engineers are having a free hand, and that the want of neither time or money is to be the cause of another failure.

## BOILER AND ENGINE FAILURES.

An interesting report is that of the chief engineer of the British Engine, Boiler and Electrical Insurance Company. And although written largely for their own company, yet it contains information of great value to the profession.

The first paragraph closes with this statement: "The ratios of breakdown of steam and gas engines have been approximately equal, viz., 1 in 9.4 and 1 in 9.1, as against 1 in 11.7 and 1 in 11.1 in 1907."

Following this are two tables showing the proportions in which the various parts of insured engines broke down. In 1908 the valves and valve gears of steam engines were responsible for 34.8 per cent. of the breakdowns. In gas engines the same parts were responsible for 31.3 per cent. of the failures. It should be noted, however, that in the case of the steam engine the number of failures was 14 per cent. above the average, and in the gas engine 1 per cent. below. Cylinders and cylinder ends were responsible for 6.2 of the failures in steam engines, but in gas 19.4. Connecting-rods and bolts—steam, 2.9; gas, 10.8, and so on throughout the tables

the efficiency of the various parts—as to wear and tear—of the two classes of engines.

From a study of the figures in each class the conclusion is arrived at, because of the increase in per cent. of breaks, that the design and workmanship on valves and valve gear is not as efficient as formerly.

The causes of breakdowns are also of some interest. To accidents and causes unascertained, 35 per cent.; old defects, 20; bad design, workmanship or material, 18, and negligence of owners or attendants, 27.

## A GREAT COMPANY'S ANNUAL REPORT.

Elsewhere we give in some detail figures from the anual report of a $459,318,424.41 company.

The Canadian Pacific Railway, with 10,543 miles of track, 1,478 locomotives, 53,000 cars and 25 lake and 38 ocean steam vessels, is first among the great transportation companies of the world, and it still grows. During the past year 403 miles were added to the system, and at the present time miles and miles of new road are under construction.

In the West, besides the building of branch lines, the C.P.R. acquired through the Minneapolis, St. Paul and Sault Ste. Marie Railway the Wisconsin Central Railway, and in the east the Orford Mountain Railway Company, a fifty-eight mile road in Quebec.

One noticeable figure in the report is the passenger income per mile. For carrying 9,784,450 passengers they received $20,153,000, or 1.88 per mile, or less than the two cents per mile that some are so anxious should be the legal fare in Canada.

This railway, run on commercial lines, serving the community so cheaply and well, has been, and will be, one of the great forces that have done so much to develop our country; and we should not forget that it took men with vision and courage to launch such an undertaking, nor that the capital invested represents a legitimate business venture, now successful, but not always so.

It was well for Canada and the credit of the country that the directors had at their disposal at the end of the year fifteen million dollars.

## EDITORIAL NOTES.

Time is not the only thing the builders of the Hydro-Electric Power Commission's line have to fight. The other day was developed an amusing phase of the work, when a conflict ensued between several farmers of Lincoln county and some members of a construction gang. According to newspaper despatches, the spoils of victory fell to the lot of the agriculturists, whose sense of fair play, however, cannot be admired. Pitchforks and shovels were their weapons of defence, or rather attack, and several of the workmen, who sustained injuries, will probably enter suits for damages. They had no desire to meet such indiscreet action.

* * * *

Owen Sound stands unique amongst Ontario towns in that it has discarded all street names and adopted numbers. Nearly sixty years ago Owen Sound was incorporated as a village, and each new street opened has added to the confusion of similar names and indefiniteness of location. By their new system all thoroughfares running north and south become avenues and number from the Sydenham River. The streets run east and west. The house numbering will be by the block system. Owen Sound council are to be congratulated for the enterprise they have shown in adopting this sensible method of street naming and house numbering. Strangers and visitors will appreciate the good points of the scheme, and Owen Sound will find she has set a good example.

## DOMINION STEEL CO. AUGUST OUTPUT.

In spite of the fact that it has been somewhat handicapped by the coal supply, the Dominion Steel Company's output in August showed a big gain, while for the past three months., as will be seen by the following figures, the output is away ahead of the corresponding months in 1908:—

| | Tons, 1909. | Tons, 1908. |
|---|---|---|
| Pig iron | 68,237 | 62,197 |
| Ingots | 80,529 | 67,916 |
| Blooms | 71,404 | 63,243 |
| Rails | 46,854 | 42,415 |
| Rods | 19,276 | 10,856 |
| Sulphate | 625 | 714 |

The shipments for the three months were 72,022 tons, against 71,745 tons last year.

## CANADIAN MINING INSTITUTE.

### Meeting of Western Branch at Nelson This Month — Members will Visit Spokane.

The sixth general meeting of the members of the western branch of the Canadian Mining Institute will be opened in Nelson, B.C., on Saturday morning, September 25th, when routine business will be transacted and several papers read and discussed.

The council of the branch having approved of the acceptance of an invitation received from the reception committee to adjourn to Spokane and there join in welcoming the American Institute of Mining Engineers to the northwest, there will be at the close of the session in Nelson an adjournment to Spokane, where a joint session of the two institutes will be held, at which several papers relative to the "Coal Resources of South-eastern British Columbia and Alberta" will be read and discussed.

## NEW LOCOMOTIVES.

### C. T. R. Orders 25 from The Canadian Locomotive Co. of Kingston.

A few days ago the Grand Trunk Railway placed an order with The Canadian Locomotive Company, Limited, of Kingston, Ontario, for twenty-five locomotives of the Mogul type. Through the courtesy of that firm we are able to publish the following particulars:—

ENGINE.

| | |
|---|---|
| Gauge | 4' 8½" |
| Type of Engine | Mogul |
| Fuel used | Bituminous Coal |
| Wheel Base of Engine, Rigid | 14' 0" |
| Wheel Base of Engine Total | 22' 7" |
| Wheel Base of Engine and Tender | 50' 3" |
| Height over all, Engine and Tender | 14' 8" |
| Heating Surface, Fire Box | 160.2 sq. ft. |
| Heating Surface, Tubes | 1551.5 sq. ft. |
| Heating Surface, Total | 1711.7 sq. ft. |
| Diameter of Driving Wheels | 63" |
| Material of Driving Wheels Centres | Cast Steel |
| Diameter and Length of Driving Journals | 9" x 10" |
| Diameter of Cylinders | 19" |
| Stroke of Cylinders | 26" |
| Type of Boiler | Extended Wagon Top, Radial Stayed |
| Working Pressure of Boiler | 180 lbs. |
| Number of Tubes | 266 |
| Diameter of Tubes | 2" |
| Length of Tubes | 10-10" |
| Injectors | No. 9 Handcock |
| Safety Valves | World |
| Brakes | Westinghouse American E. T. |
| Kind of Packing | U. S. Metallic |

TENDER.

| | |
|---|---|
| Weight of Tender, Loaded | 138,800 lbs. |
| Capacity of Tank in Imp. Gallons | 6,000 |
| Style of Tank | Water Bottom |
| Coal Capacity | 10 Tons |
| Style of Truck | Arch Bar Type, Cast Steel Bolster |
| Diameter of Wheel | 34" |
| Kind of Wheel | Cast Steel Centre, Steel Tired |
| Diameter and Length of Journal | 5½" x 10" |
| Brake Beam | Ry. Co. Standard |

## AGE OF MUNICIPAL EMPLOYEES.

The labor force in the average city is overloaded with superannuated men, many of whom had already passed their years of active service or usefulness at the time of their appointment to the city's service. As a result the city virtually pensions these men at full pay, a rate at least double that contemplated by the ordinary pension system. This naturally makes a rank injustice to the men who have grown old in the service of the city and exerts an influence demoralizing in its effect upon the efficiency of the force. While age alone is less potent as a cause of inefficiency than others which must be considered in connection with municipal work, nevertheless it demands careful consideration.

This has been given in the searching analysis made by Metcalf & Eddy, of Boston, consulting engineers to the Finance Commission, in their investigation of the Boston Water and Sewer Departments. In the case of the former it was found that with a force of 538 men the average age was forty-nine years and the average length of service about thirteen years; and, what is not apparent from this simple statement of fact, the average age at time of appointment is much greater now than it was some years ago, so that if the present policy of appointing men upwards of forty or even fifty years of age to do the work properly belonging to young and vigorous men is persisted in, the efficiency of the labor force is bound to be more and more seriously affected. This becomes clearly evident when we consider that most of the employees to-day are drawn from the ranks of city-bred men, whereas twenty years ago the labor was drawn mostly from the country, and moreover from a class accustomed to hard manual labor.

The average ages at time of appointment of the men in the labor force are shown in the following tabulation:

**Ages at Time of Appointment of Men Now in Labor Force.**

| | Distribution Division. | | Income Division. | |
|---|---|---|---|---|
| Age when Appointed. | Per Cent. of Force. | No. of Men. | Per Cent. of Force. | No. of Men |
| Under 20 | 4.0 | 19 | 4.6 | 3 |
| 20-25 | 9.1 | 43 | 7.6 | 5 |
| 25-30 | 18.4 | 87 | 12.2 | 8 |
| 30-35 | 16.5 | 78 | 16.7 | 11 |
| 35-40 | 16.3 | 77 | 19.8 | 13 |
| 40-45 | 12.8 | 60 | 16.7 | 11 |
| 45-50 | 14.4 | 68 | 12.1 | 8 |
| Over 50 | 8.5 | 40 | 10.3 | 7 |
| Total | 100.0 | 472 | 100.0 | 66 |

A study of the relation of length of service to ages of employees indicates clearly that the average term of service does not keep pace with the increased age of the employees.

Substantially the same conditions prevail in the Sewer Department. It further appears that whereas in the Sewer Division 13 per cent. of the labor force is composed of men over sixty years of age, in the Water Department, as shown in the following table, nearly 18 per cent. of the labor force in the Distribution Division, and 16½ per cent. in the Income Division, are over sixty years of age; and whereas in the Sewer Division about 31 per cent. of the present labor force were appointed when they were more than forty years of age, nearly 36 per cent. of the force in the Distribution Division and over 39 per cent. of that in the Income Division were over forty at the time of their appointment. Doubtless this condition would be even more marked in both departments if it were feasible to tabulate the ages of all the men who were appointed to the force in former years, since it is a safe conclusion that there were men appointed when over forty years of age who are now by reason of death or resignation no longer connected with the force:—

**Boston Water Department.**

**Percentage of the Total Labor Forces who are Older or Younger than Designated Age.**

| | Distribution Division. Percentage of Labor Force who are | | Income Division. Percentage of Labor Force who are | |
|---|---|---|---|---|
| Present Age. | Older. | Younger. | Older. | Younger. |
| 20 | 99.8 | 0.2 | 100.0 | — |
| 25 | 99.2 | 0.8 | 98.5 | 1.5 |
| 30 | 96.9 | 3.1 | 97.0 | 3.0 |
| 35 | 92.9 | 7.1 | 94.0 | 6.0 |
| 40 | 83.8 | 16.2 | 82.0 | 18.0 |
| 45 | 70.5 | 29.5 | 65.5 | 34.5 |
| 50 | 57.0 | 49.0 | 45.5 | 54.5 |
| 55 | 33.6 | 66.4 | 36.5 | 63.5 |
| 60 | 17.7 | 82.3 | 16.5 | 83.5 |
| 65 | 7.7 | 92.3 | 6.0 | 94.0 |
| 70 | 2.6 | 97.4 | 1.5 | 98.5 |
| 75 | 1.3 | 98.7 | — | 100.0 |

## RAILWAY ORDERS.

7865—August 20—Approving location of C.P.R. station at McTaggart, Sask.

7866—August 20—Authorizing the C.P.R. to construct an extra track across road allowance between Sections 21 and 16, Township 10, Range 20, west Principal Meridian, Manitoba.

7867—Aug. 20—Authorizing the C.P.R. to reconstruct bridge No. 113.9, over the Illecillewaet River, B.C.

7866—August 24—Authorizing the town of Barrie, Ont., to lay sewer under tracks of G.T.R. at Essa Street.

7869 and 7870—August 24—Authorizing the Bell Telephone Company to erect an underground conduit across tracks of G.T.R. and Michigan Central Railways at Waterloo Street, London, Ont.

7871—August 20—Rescinding Order No. 7749, dated August 7th, 1909, in re G.T.R. station at Guelph, Ont., and staying proceedings under Order No. 7394, June 28th, 1909, in same matter, until the question of subway at Neeve Street is disposed of.

7872—August 20—Authorizing the Pembroke Southern Railway Company to construct spur to the Lee Manufacturing Co., Pembroke, Ont.

7873—August 20—Directing the C.P.R. to provide and construct two level highway crossings over public highway known as the Gravel Pit and Andrews Road Crossing, in the district of Matsqui, B.C.

7874—August 20—Approving location of C.P.R. Station at Gull Lake, Sask.

7875—August 20—Authorizing the C.P.R. to construct branch to the Rogers-Cunningham Lumber Company, Ltd., Lethbridge, Alta.

7876—August 20—Authorizing the C.P.R. to construct spur to the premises of the Citizens Lumber Company, Lethbridge, Alta.

7877—August 20—Authorizing the C.P.R. to construct spur to the premises of J. Wilson, Parish of Vaudreuil, Que.

7878—August 24—Authorizing the C.P.R. to construct spur to the Alberta Lumber Company, Vancouver, B.C.

7879—August 24—Authorizing the C.P.R. to construct spur through blocks 21, 12, and 5, and across the lanes and streets in the town of Saskatoon, Sask.

7880—August 19—Dismissing the application of the C.P.R. for Order No. 6856, dated April 17, 1909, by providing that the wires at the crossings of the Seymour Power & Electric Company, Ltd., shall be supported by a four-pole structure on each side of the track.

## STRESSES IN MASONRY DAMS.*

By William Cain, M. Am. Soc. C.E.

The object of this investigation is to determine the amounts and distribution of the stresses in a masonry dam, at points not too near the foundations, having assumed the usual "law of the trapezoid," that vertical unit pressures on horizontal planes vary uniformly from face to face.

Experiment indicates that such vertical stresses increase pretty regularly in going from the inner to the outer face, for reservoir full, until we near the down-stream or outer face, where the stress gradually changes to a decreasing one, which decrease continues to the end of the horizontal section. The law of the trapezoid is thus only approximately true over part of the section, but, as it gives an excess pressure where it attains a maximum, it errs on the safe side.

The profile of the dam selected is of the triangular type, with some additions at the top, but the method used in determining the stresses is general, and will apply to any type of profile. The final equations will give at any (interior or exterior) point of horizontal section considered the vertical unit stress on the horizontal section, the normal stress on a vertical plane, and the unit shear on either horizontal or vertical planes. From these stresses, the maximum and

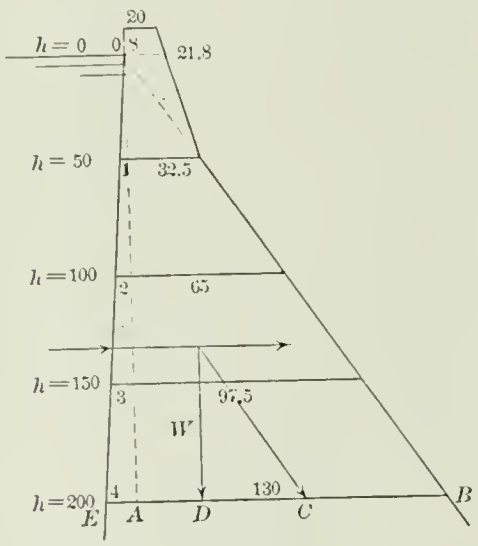



Fig. 1.

minimum normal stresses, and the planes on which they act, can be determined, and ultimately, if desired, the stress on any assumed plane can be ascertained.

The solution presented is approximate, which is justifiable in view of the approximation involved in "the law of the trapezoid" used. The results, however, are practically correct, as will be evident from the checks applied, resulting from the exact theory given in the Appendix. The theory used, being simple, should be easily followed.

Let Fig. 1 represent a slice of the dam contained between two vertical parallel planes, 1 ft. apart and perpendicular to the faces. The batter of O B is, $\frac{130}{200} = \frac{0.65}{1}$; that of O E being $\frac{4}{200} = \frac{0.02}{1}$. The batter of the inner face was found by trial, so that the centers of pressure on horizontal sections, for reservoir empty, should nowhere pass more than a fraction of a foot outside the middle third of the section. The simple type of profile shown was adopted for ease of computation.

For convenience in subsequent computations, the breadth, b = E B, of horizontal sections, corresponding to various depths, h, below the surface of the water in the reservoir, are given, all dimensions being in feet:

h = 199.0, b = 133.330
h = 199.5, b = 133,665
h = 200.0, b = 134.000
h = 200.5, b = 134,335
h = 201.0, b = 134,670

Take the weight of 1 cu. ft. of masonry equal to 1; then the weight of masonry above any section is equal to the corresponding area in Fig. 1 above that section. The area of the portion above E O B is readily found to be 712, and its moment about the vertical, A O, is 11 603, the unit of length being the foot. In Fig. 1, D is where the vertical through the centre of gravity of the dam above the joint, E B, cuts that joint, and C is the centre of pressure on that joint when the water pressure on E O is combined with the weight of masonry, W, above E B.

As h varies, suppose each horizontal joint, in turn, marked similarly to the joint at h = 200, with the letters E, A, D, C, B; then, for any joint, on taking moments of the triangles, A O B, A O E, and the area above O B, we find,

$$A D = \frac{\frac{A O}{6}(A B^2 - E A^2) + 11\ 603}{W}$$

Assuming that the masonry weighs 2½ times the water per cubic unit, then the weight of a cubic foot of water is $\frac{2}{5}$. It would entail but little extra trouble here, where the inner face has a uniform batter throughout, to include the vertical component of the water pressure on the face, E O; but it will be neglected as usual.

The horizontal water pressure for the height, h, is thus, $\frac{2}{5} \times \frac{h^2}{2} = \frac{1}{5} h^2$, and its moment about C is, $\frac{1}{5} h^2 \times \frac{1}{3} h = \frac{1}{15} h^3$.

Taking moments of W and water pressure about C, we have at once,

$$D C = \frac{1}{15} \times \frac{h^3}{W}.$$

From the last two formulae, we derive the following results:

| h | W | A D | D C |
|---|---|---|---|
| 199 | 13 978.335 | 40.49141 | 37.58483 |
| 200 | 14 112.000 | 40.70316 | 37.79289 |
| 201 | 14 246.335 | 40.91488 | 38.00089 |

A seven-place logarithmic table was used throughout, the aim in the computations being to get the seventh significant figure correct within one or two units. The necessity for this accuracy will be seen later.

The distances, E C and C B, are now readily derived.

For, h = 199, E C = 82.05624, C B = 51.27376
h = 200, E C = 82.49605, C B = 51.50395
h = 201, E C = 82.93577, C B = 51.73423.

On any plane, E B, the vertical unit pressure,

$$\text{at } B = p_1 = \frac{4b - 6\,C\,B}{b^2} W,$$

$$\text{at } E = p_2 = \frac{4b - 6\,E\,C}{b^2} W;$$

where b = E B, and W is the weight of masonry above the plane. This follows from the assumed "law of the trapezoid."

From these formulae we derive,

At h = 199, $p_1$ = 177.45483, $p_2$ = 32.22542,
h = 200, $p_1$ = 178.3855, $p_2$ = 32.24139,
h = 201, $p_1$ = 179.3160, $p_2$ = 32.25798.

Call p the vertical unit stress at a distance, x', from E; then,

$$p = p_2 + \frac{p_1 - p_2}{b} x';$$

and the total stress on the base, x', is,

$$P = \frac{1}{2}[p_2 + p]\,x' = p_2 x' + \frac{p_1 - p_2}{2b} x' \quad \ldots\ldots\ldots\ldots (1)$$

*Proceedings of the American Society of Civil Engineers Vol. XXXV. Page 38, not read before the Society.

To find the unit shear on vertical or horizontal planes*, consider a slice of the dam, bounded by horizontal planes at h = 199 and h = 200, the water face and a vertical plane, at a distance, x, from the inner face (Fig. 2), in equilibrium under the water pressure acting horizontally on its left face and the forces exerted by the other parts of the dam on the slice. These forces consist of the uniformly increasing stress, P', on top, acting down; the uniformly increasing stress, P, on the bottom, acting up; a shear acting on the vertical plane at the right, of average intensity $q_1$ per square foot; the weight of the body (x — 0.01), besides the horizontal forces to be given later. The vertical component of the water pressure is here neglected, as usual. The origin for x is taken, here and in all subsequent work, at the level, h = 200, at the inner face.

For equilibrium, the sum of the vertical components must be zero.

Therefore, $q_1 = (x - 0.01) + P' - P$ ..... (2)

To find P', substitute in Equation 1, $x' = x - 0.02$, $p_2 = 32.22542$, $p_1 - p_2 = 145.22941$, b = 133.330, giving $P' = 32.20364\ x + 0.5446238\ x^2 - 0.6442906$. P, $x' = x$, $p_2 = 32.24139$, $p_1 - p_2 = 146.1441$, and b = 134; therefore

$$P = 32.24139\ x + 0.5453138\ x^2.$$

Substituting in Equation 2, we derive the average unit shear,

$$q_1 = -0.6542906 - 0.96225\ x - 0.0006900\ x^2 \ldots (3)$$

This value of $q_1$ is strictly correct when $x > 0.02$. It is slightly in error when $0 < x < 0.02$.

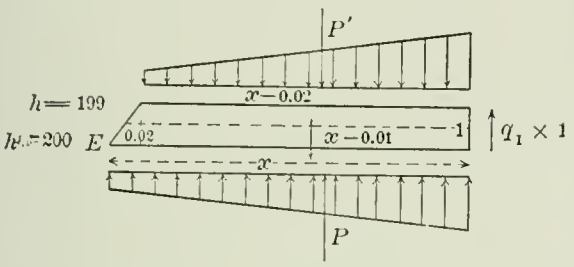



Fig. 2.

A similar investigation holds to obtain the average unit shear $q_2$ (Fig. 3) on a vertical plane, at a distance, x, from E, extending from the level, h = 200, to the level, h = 201.

We have, for equilibrium,

$$q_2 = (x + 0.01) + P - P'' \ldots\ldots (4)$$

We find P'' by substituting in Equation 1, $x' = (x + 0.02)$, $p_2 = 32.25798$, $p_1 - p_2 = 147.05802$, and b = 134.67. $P'' = 32.27982\ x + 0.5459941\ x^2 + 0.6453780$. Substituting this, and the value previously found for P, in Equation 4, we derive,

$$q_2 = -0.6353780 - 0.96157\ x - 0.0006803\ x^2 \ldots\ldots (5)$$

This is strictly correct only when $x > 0$.

The mean, $\frac{1}{2}(q_1 + q_2)$, of these average shears will be assumed as approximately equal to the intensity of shear at the point, G (x = E G), at the level, h = 200. Call q this intensity of shear on a vertical plane at G; therefore,

$$q = -0.6448343 + 0.96191\ x - 0.0006856\ x^2 \ldots\ldots (6)$$

Checks.—By Appendix (b) and (d), the exact value of q, at either face, = p tan. $\phi$, where p = vertical unit normal stress at the face and $\phi$ is the angle the face makes with the vertical. Thus, at the inner face, q = — 32.24139 × 0.02 = — 0.6448278, whereas Equation 6 gives, for x = 0, q = — 0.6448343.

At the outer face, the exact value is, 178.3855 × 0.65 = 115.9500, whereas Equation 6 gives, for x = 134, q = 115.9405.

A still more searching test can be devised. It is a well-known principle that the intensity of shear at a point on vertical or horizontal planes, is the same [Appendix (a)]. Therefore, regarding Equation 6 as giving the horizontal unit shear, at the level, h = 200, where b = 134 ft.; the total shear, from face to face, on this level, is,

$$\int_{x=0}^{x=134} q\ dx = 7999.75$$

This should equal the total water pressure down to the same level, $\frac{1}{5}(200)^2 = 8\,000$. Formula 6 thus gives practically exact results.

In order to find the normal unit stress on a vertical plane, we shall assume that $q_1$, given by Equation 3, equals the intensity of shear on a vertical or horizontal plane at the point x, at h = 199.5; and that $q_2$, given by Equation 5, gives the shear intensity at x at h = 200.5. This evidently supposes that the shear intensity increases uniformly, vertically, from h = 199 to h = 201.

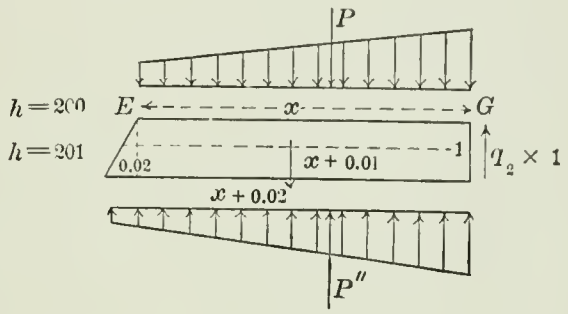



Fig. 3.

Consider a portion of the dam, Fig. 4, bounded by the water face; the plane, F M, at the level, h = 199.5, on which the total shear is Q', the plane, E N, at the level 200.5, on which the total shear is q, and the vertical plane, M N, 1 sq. ft. in area, on which the average normal stress is p'. The water pressure on E F will be supposed to be exerted horizontally. It is equal to 80 units. Assuming, as stated, that $q_1$ = intensity of horizontal shear at M, and $q_2$ = the corresponding intensity at N, we have, taking the origin as before, O,

$$Q' = \int_{0.01}^{x} q_1\ dx; \qquad Q = \int_{-0.01}^{x} q_2\ dx;$$

or,

$$Q' = 0.006494794 - 0.6542906\ x + 0.481125\ x^2 - 0.00023\ x^3$$

$$Q = -0.00640186 - 0.6353780\ x + 0.480785\ x^2 - 0.0006803\ \frac{x^3}{3}$$

Checks.—The total water pressure for h = 199.5 is $\frac{1}{5}(199.5)^2 = 7960.05$ and for h = 200.5, $\frac{1}{5}(200.5)^2 = 8\,040.05$. The first should equal Q', for x = 133.665, or 7 059.22; the second should equal Q, for x = 134.335, or 8 041.12. The slight differences tend to give confidence in the results.

For equilibrium, the sum of the horizontal forces acting on E F M N, Fig. 4, must be zero;

$$\text{therefore, } p' = 80 + Q - Q' \ldots\ldots (7)$$

$$p' = 80.01 - 0.0189\ x + 0.00034\ x^2 - 0.00000323\ x^3.$$

This average stress will now be assumed to be the intensity of the horizontal unit stress on vertical planes at h = 200.

It will now be perceived why a seven-place table was necessary in the computations, the coefficients of $x^2$ and $x^3$

* The writer desires here to acknowledge his indebtedness to a recent paper on "Stresses in Masonry Dams" by Ernest Prescot Hill, M. Inst. C. E., published in Minutes of Proceedings, Inst. C. E., Vol. CLXXII., p. 134. Mr. Hill considers the case of a dam with a vertical inner face. By the aid of the calculus, he effects an exact solution, which leads to general formulae for shear and normal pressures on vertical planes.

Mr. Hill ascribes to Professor W. C. Unwin the suggestion, "that the shearing stress at any point may be found by considering the difference between the total net vertical reactions [between that point and either face] along two horizontal planes at unit distance apart," and states that Prof. Unwin "has applied the principle to a triangular dam by the use of algebraical methods."

having only two or three significant figures in the final result. If the planes originally had been taken 0.1 ft. apart vertically, a ten-place table would have been required.

Checks.—The value of p′, for x = 0, p′ = 80.012896, is the same as that given by Appendix (a), 80 + 0.6448 × 0.02. When x = 134, the formula gives p′ = 75.81, whereas the exact theory, Appendix (b), gives p′ = $m^2$ p = $(0.65)^2$ × 178.39 = 75.37. The difference is 0.44 at the outer face. For any other point, it might be assumed to vary with x, so that it could be corrected by subtracting $\frac{0.44}{134}$ x = 0.0033 x from the value of p′ above. For ease of computation, the formula will be written,

$$p' = 80.01 - 0.02\,x + 0.00034\,x^2 - 0.00001\,\frac{x^3}{3} \quad \ldots\ldots (8)$$

The first coefficient of $x^3$ cannot be counted on to the last two figures, hence we are permitted to change 323 to 333 in that coefficient. When x = 134, Equation 8 gives p′ = 75.41, nearly the exact value.

The three formulae for p, q and p′, at the level h = 200, are thus as follows:—

$$p = 32.24 + 1.09063\,x.$$

$$q = -0.64 + 0.962\,x - 0.000686\,x^2.$$

$$p' = 80.01 - 0.02\,x + 0.00034\,x^2 - 0.00001\,\frac{x^3}{3}.$$

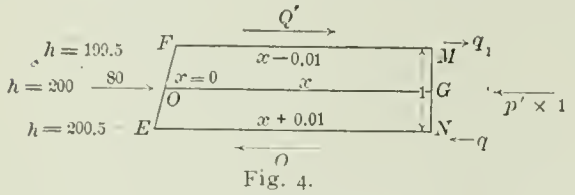


Fig. 4.

Since the weight per cubic foot of masonry was assumed as two and one-half times that of water, we must multiply the stresses given in Table 1 by $\frac{5}{2}$ (62.5) = 156.25, to reduce to pounds per square foot; or by 1.085, to reduce to pounds per square inch.

TABLE 1.

| x | 0 | 10 | 25 | 50 | 75 | 100 | 134 |
|---|---|---|---|---|---|---|---|
| p′ | 32.24 | 43.15 | 59.50 | 86.77 | 114.04 | 141.30 | 178.39 |
| q | —0.64 | 8.91 | 22.98 | 45.75 | 67.65 | 88.70 | 115.95 |
| p′ | 80.01 | 80.02 | 79.66 | 79.11 | 79.01 | 78.08 | 75.37 |
| max f | 80.02 | 82.06 | 94.67 | 128.85 | 166.40 | 203.85 | 253.71 |
| min. f | 32.23 | 41.11 | 44.48 | 37.03 | 26.64 | 15.52 | 0 |
| θ for max. f. | 90°46′ | 76°06′ | 56°50′ | 42°36′ | 37°44′ | 35°12′ | 33°01′ |

In Table 1 the stresses are those experienced at the level, h = 20.

p = vertical unit stress on a horizontal plane,

q = shearing unit stress on horizontal or vertical planes,

p′ = horizontal unit stress on vertical planes,

Max. f = maximum normal stress acting on a plane inclined to the horizontal at the angle θ, given on the last line,

Min. f = minimum normal stress acting on a plane perpendicular to the last.

From max. f and min.f, with θ, the ellipse of stress can be drawn, and the stress in any direction, with the plane on which it acts, can be ascertained.

It will be observed that there is no tension exerted anywhere, and that the maximum compression is 253.71, or 275 lb. per sq. in., which is exerted at the outer face, upon a plane at right angles to the face.

In Appendix (e), the important formula, for the maximum normal intensity at the outer face, acting parallel to that face,

$$f = \frac{p}{\cos.^3\phi}$$

is proved. In this instance, p = 178.39, tan. φ = 0.65, therefore φ = 33°01′, whence f = 253.71.

This stress is unaccompanied with any conjugate stress, perpendicular to the face. In the interior of the dam, where conjugate stresses prevail, the masonry is perhaps better able to withstand a certain compressive stress than at the face. The distribution of stresses, at the level h = 200, is shown in Fig. 5, on the supposition that the base of the dam is a little below that level. The connection with the foundation materially modifies this distribution; but Fig. 5

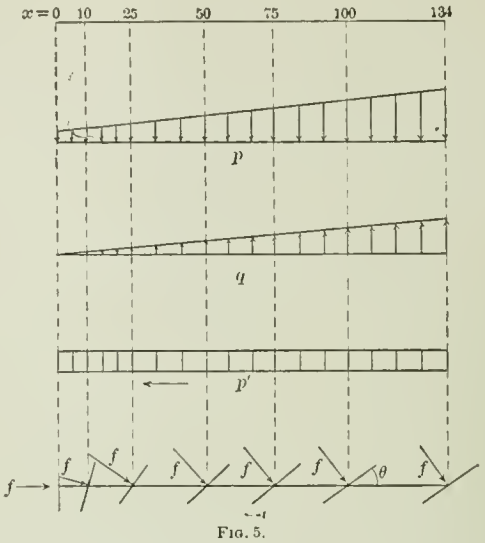


Fig. 5.

shows the distribution for sections, say, from 10 to 20 ft. above the base, up to the level h = 50, fairly well, on the basis of the trapezoid law. As has been mentioned before, this law gives a pressure greater than the actual at the outer face.

Since the batter of the inner face is very small, the results of Table 1 should agree approximately, except near the inner face, with those found by Mr. Hill in the paper referred to in the foot-note. Substituting numerical values, Mr. Hill's formulae, for h = 200, reduce to,

$$q = 0.9426\,x - 0.0005768\,x^2,$$

$$p' = 80 - 0.0001289\,x^2 - 0.0000009615\,x^3;$$

giving,

| x | 0 | 10 | 25 | 50 | 75 | 100 | 134 |
|---|---|---|---|---|---|---|---|
| q | 0 | 9.36 | 23.20 | 45.69 | 67.45 | 88.49 | 115.95 |
| p′ | 80 | 79.99 | 79.90 | 79.56 | 78.87 | 77.75 | 75.38 |

To be concluded in next issue.

## EDMONTON STREET RAILWAY.

The total number of passengers carried by the Edmonton Street Railway since the commencement of operations on the 9th November, 1908, to August 31st, 1909, was 1,347,600. For the month of August the number was 193,704. The net earnings in August were $8,161.87.

The Halifax Electric Company's gross earnings for the week of September 7th, 1909, were $4,719.70, a decrease of $2,315.23, and from January 1st, $122,512.95, an increase of $565,976.

The earnings of the Toronto Street Railway for the week ended September 11th, 1909, show an increase of $7,542.61 as compared with the figures for the same week in 1908. 1909, $114,488.66; 1908, $106,946.05.

Mr. W. H. Jones, acting superintendent of the Idaho division of the Oregon Short Line Railway, accompanied by four minor officials of the same railway, were in Montreal recently. They are looking over the Canadian roads for pointers and will make a full report of their observations to Mr. Julius Kruttchnitt, director of maintenance and operation of all Harriman roads in America and Mexico, who will decide as to the advisability of adopting Canadian methods.

## N. T. RAILWAY.

The steel has been put down for 40 miles west of Cochrane on the Transcontinental Railway, and will be extended twenty miles further within the next thirty days.

Two temporary bridges had to be built, the permanent steel structure will be put in place during the winter. The grade is practically completed for 100 miles west of Cochrane.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Sept. 7 | | STOCK QUOTATIONS — TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Sept. 10 '08 | Price Sept. 2 '09 | Price Sept. 9 '09 | Sales Week End'd Sept. 9 | Price Sept. 10 '08 | Price Sept. 2 '09 | Price Sept. 9 '09 | Sales Week End'd Sept. 9 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $1,664,000 | 1,301,000 | ..... | 182 | 180½ | 180½ 620 | 174½ | 174½ | 183 | 182 181 180 715 |
| Canadian Northern Railway | 2,986.9 | ... | ... | 199,400 | 175,300 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 939,143 | 821,962 | ..... | *1st. pref. 107½, 3rd pref. 68¾, ordinary 21¼ | | | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | 34,965 | 18,925 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 75,062 | 74,118 | ..... | ..... | ..... | ..... | 171 | 170 | 213 | 212½ 225½ 214 383 |
| Toronto Street Railway | 114 | 8,000 | 100 | 93,643 | 88,125 | 106 | 126½ | 126 126 | 125½ 110 | 105½ | 105½ | 126 | 125½ 125½ 125 460 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 170 | 190 | 187 | 187 21 | 170 | 165 | | 187 187 ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## CANADIAN PACIFIC RAILWAY COMPANY'S ANNUAL REPORT FOR THE YEAR ENDING JUNE 30th, 1909

The annual report of the Canadian Pacific Railway for the year ending June 30th, 1909, shows total earnings amounting to $76,313,320.96. These earnings were made up as follows: Passengers, $20,153,000.83; freight, $48,182,520.11; mails, $778,822.35; and sleeping cars, express elevators, telegraph and miscellaneous $7,198,977.67.

The working expenses for the year amounted to $53,357,748.06, thus the working expenses amounted to 69.92 per cent. of the gross earnings, and the net earnings to 30.08 per cent. as compared with 69.47 and 30.53 per cent. for 1908.

### Equipment.

The equipment of the road consists of:—

| | |
|---|---|
| Locomotives | 1,478 |
| *First and second-class Passenger cars, Baggage cars and Colonist sleeping cars | 1,461 |
| First-class sleeping, dining and café cars | 275 |
| Parlor cars, Official and Paymasters' cars | 60 |
| Freight and cattle cars (all kinds) | 47,748 |
| Conductors' Vans | 797 |
| Boarding, Tool and Auxiliary Cars and Steam Shovels | 3,013 |

*Includes cars in Line Service

As denoting the volume of freight handled this following table is of interest:—

### Description of Freight Forwarded

| | | Year Ended June 30th 1908 | 1909 |
|---|---|---|---|
| Flour | Barrels | 5,843,988 | 6,683,354 |
| Grain | Bushels | 88,345,234 | 97,236,150 |
| Live Stock | Head | 1,349,771 | 1,371,873 |
| Lumber | Feet | 1,764,445,495 | 1,726,944,584 |
| Firewood | Cords | 249,605 | 249,628 |
| Man. Articles | Tons | 3,981,888 | 4,425,241 |
| All oth'r Articles | Tons | 5,102,116 | 5,916,248 |

Passenger rates is a favorite discussion for some daily papers. A two-cent-rate is demanded on all steam lines and in view of this the passenger traffic table for three years gives instructive results.

| | Year Ended June 30th 1907 | 1908 | 1909 |
|---|---|---|---|
| No. of pass'gers carried | 8,779,620 | 9,463,179 | 9,784,450 |
| Ear'gs per pass. per m. | 1.83 Cents | 1.89 Cents | 1.88 Cents |

The system is divided into seven divisions with the following mileage:—

| | |
|---|---|
| Eastern Division | 1494.2 miles |
| Ontario Division | 1124.9 " |
| Lake Superior Division | 1102.7 " |
| Atlantic Division | 691.4 " |
| Central Division | 2905.9 " |
| Western Division | 2146.4 " |
| Pacific Division | 1077.9 " |

Making a total mileage of 10,543.4.

## RAILWAY EARNINGS.

A number of railroads have now reported for the four weeks of August, total gross earnings being $39,069,423, an increase of 12.0 per cent. over last year, and a loss of only 4.4 per cent. compared with August, 1907. Good gains are reported by all roads over last year, especially in the southwest, and compared with 1907 considerable improvement is shown, earnings on some of the roads included being very near the record for that year, when traffic was heavy. In the following table is given earnings of United States roads reporting for August and the two preceding months:—

Gross earnings,

| | 1909. | Gain. | Per cent. |
|---|---|---|---|
| August | $39,069,423 | $4,187,318 | 12.0 |
| July | 22,681,294 | 1,271,582 | 5.9 |
| June | 28,107,294 | 2,698,040 | 10.6 |

The classified statement for July is now practically complete and shows total gross earnings of United States roads included of $139,541,851, an increase of 10.9 per cent. over last year, and a loss of 6.7 per cent. compared with 1907. Considerable gains are shown by a number of systems as compared with last year, notable on the Eastern Trunk lines, Granger and Southwestern roads; also on the Western Trunk lines and other Eastern. The statement is printed below:—

Gross earnings,

| July. | 1909. | Gain. | Per cent. |
|---|---|---|---|
| Trunk eastern | $ 27,781,829 | $ 3,583,864 | 14.8 |
| Trunk western | 16,649,145 | 1,729,391 | 11.6 |
| Coal | 7,701,928 | 482,298 | 6.7 |
| Other eastern | 3,383,503 | 346,291 | 11.4 |
| Central western | 6,254,183 | 284,985 | 4.8 |
| Granger | 14,151,534 | 1,681,956 | 13.5 |
| Southern | 17,768,807 | 998,730 | 6.0 |
| Southwestern | 22,366,524 | 2,046,206 | 10.1 |
| Pacific | 23,484,398 | 2,563,815 | 12.3 |
| United States roads | $139,541,851 | $13,717,457 | 10.9 |
| Canadian | 7,004,000 | 808,000 | 13.1 |
| Mexican | 4,422,621 | 209,588 | 5.1 |
| Total | $150,968,472 | $14,735,045 | 10.8 |

—Dun's Review.

## WINNIPEG ELECTRIC RAILWAY FOR JULY, WITH COMPARISONS.

The earnings of the Winnipeg Electric Railway Company for July show a very substantial increase over those of the previous year. They are given below, together with those for the first seven months of the year:—

| | —July— 1909. | 1908. |
|---|---|---|
| Gross | $ 214,087 | $ 178,688 |
| Operating | 100,714 | 89,718 |
| Net | 113,373 | 88,970 |
| Surplus | 76,942 | 56,434 |
| | Seven Months. | |
| Gross | $1,424,991 | $1,197,962 |
| Operating | 709,539 | 598,981 |
| Net | 715,452 | 598,981 |

The net surplus in August was equivalent to 15.36 per cent. on the common stock. The surplus for the seven months is at the rate of over 16 per cent.

The increase for the first seven months is $227,029, and the increase in Toronto for the first eight months was $202,000. In Montreal the increase for the first eight months was $135,000.

## LATE CONSTRUCTION NEWS.

### TENDERS.

BARRIE.—Tenders for the construction of the sewage outfall works in connection with the Allandale sewers, now under construction, were opened this week, but in the judgement of the committee and engineer were not acceptable; the town is advertising again in these columns calling for tenders to be in on September 30th, 1909. C. H. & P. H. Mitchell, consulting engineers, Toronto.

### MONTREAL AQUEDUCT.

The Waterworks Department have not yet awarded the contract for widening, from 40 to 140 feet, the aqueduct between Lachine and Montreal. On Tuesday the following tenders were opened. Superintendent Janin estimated that the work would cost $1,284,754.

| | |
|---|---|
| Quinlan & Robertson, Montreal | $ 815,690 |
| Manley & Co., Toronto | 856,900 |
| Canadian General Development Co., Montreal | 890,700 |
| Cavicchi & Paganlo, Notre Dame du Lac, Que. | 948,280 |
| Nova Scotia Construction Co., Sydney | 1,047,950 |
| Larkin & Sangster, Trenton, Ont. | 1,099,720 |
| Laurin & Leitch, Montreal | 1,115,875 |
| F. H. McGuigan, Toronto | 1,205,660 |
| M. Connelly, Montreal | 1,242,280 |
| P. McGoverin, Boston | 1,294,380 |
| P. Mullarkey, Montreal | 1,471,205 |

## CURRENT NEWS.

**Ontario.**

NIAGARA FALLS.—Chippewa is to have another large industry, five acres of the racecourse having been purchased for a site for the Electric Furnace Products Company's plant. Building operations are to begin at once. About 50 hands will be employed, which number will ultimately be more than trebled. The main building will be 180 by 125 feet, of brick, steel and concrete. The company will manufacture railroad switches and rails.

**Manitoba.**

WINNIPEG.—The C.P.R. despatchers are now handling trains between here and Brandon by telephone over the system which has recently been installed. The work is merely experimental, but if it is successful the telephone will largely supplant the telegraph.

WINNIPEG.—The iron working and steel industries of the West are making great strides this year. The Dominion Bridge Co., Western Canada branch, report that the last three months represent more business than in the twelve months of 1908. In July and August they closed contracts for steel in the many large buildings, all shopped in Winnipeg works.

WINNIPEG.—The Manitoba Rolling Mills are being rapidly pushed forward to completion. The main building, which will be utilized for blast furnace work, is 240 feet long and 150 feet wide, and is erected upon cement pillars. The furnaces will be installed at an early date.

**British Columbia.**

VERNON.—Representatives of several municipalities in this district, including City Engineer Hawkes, recently petitioned the Forestry Commission to recognize the importance of preserving the timber areas of Mt. Aberdeen and thereby safeguard the water supply of the neighborhood.

## MISCELLANEOUS.

**Ontario.**

TORONTO.—The Ontario Government will take steps to proceed with the reconstruction of the damaged portion of the Parliament buildings at once. A fireproof roof will be placed on the damaged part of the building, and the question of extending this system of roofing over the entire structure will be considered.

WINNIPEG.—Mr. C. J. Brown, city clerk, has given notice of the city's intention to construct numerous sewers, granolithic walks, etc.

WINNIPEG.—The steel work on the twelve-storey J. D. McArthur Building, in which 1,200 tons of steel was used was completed on September 1st, the exact date specified in the contract. This is a record in steel construction, as the first column was not put in place until June 21st. The Dominion Bridge Company were the contractors for the steel as well as the erection, and Mr. M. W. Julien, superintendent of construction for the company, had direct charge of the work, having 52 men employed. A remarkable fact in connection with the steel work on this immense building was that not one serious accident occurred.

**Saskatchewan.**

REGINA.—The following information in regard to building returns in Regina is furnished by Mr. Angus Smith, city engineer:

| | No. | Value | | Increase |
|---|---|---|---|---|
| August 1909 | 30 | $168,224 | ..... | 8.87 % |
| August 1908 | 20 | 153,112 | ..... | |
| Jany. to Aug., 1909 | 203 | 598,869 | ..... | 62.79 % |
| Jany. to Aug., 1908 | 180 | 367,470 | ..... | |

**British Columbia.**

COMOX.—E. Millett is building a bridge over Boynes River.

## PERSONAL.

MR. G. S. SCOTT, S. P. S., '05, has been appointed assistant in mineralogy by the University of Toronto.

MR. S. DUSHMAN, B.A., has been appointed lecturer in electro-chemistry for the year 1909-10 by the University of Toronto.

MR. C. R. YOUNG, B.A.Sc., has been re-appointed lecturer in Applied Mechanics by the University of Toronto for 1909-10.

MR. FRANK SCOTT, treasurer of the Grand Trunk Railway, has been elected president of the International Association of Railway Financial Officers.

MR. J. GRANT MACGREGOR, formerly of Goderich, Ont., has been appointed chief engineer for the Alberta Central Railway Co., with head offices at Red Deer, Alberta.

MR. W. W. POPE, K.C., for twenty years connected with the solicitor's office of the G. T. R., was recently appointed Secretary to the Hydro-electric Power Commission.

ALDERMEN CROWE, MORTON and MacMILLAN, of Vancouver, B.C., accompanied by Building Inspector Jarrett, will visit Seattle, St. Joseph, Mo., Chicago, and other cities to inspect the newer methods of paving, incinerator plants, building conditions, etc. They left this week on their mission.

MR. JAMES H. NORRIS, for the past nine years business manager of the John F. Allen Riveting Machine Company, 370-372 Gerard Avenue, New York City, has resigned to take a rest of about two months, part of which is to be spent on an extended trip. He has not yet formed any definite future connection, but has several positions under consideration.

MESSRS. SMITH, KERRY & CHACE, engineers; head office, Toronto; have just opened a branch at 71 Fairfield Building, Vancouver, B.C., where they will carry on British Columbia and Pacific Coast work. Mr. H. J. Haffner, McGill, 1904, who is in charge, is experienced in railway, municipal and irrigation engineering. It is proposed to do general business, including, in particular, water-power electrical development. Considerable irrigation and hydro-electric work will be handled.

## OBITUARY.

MR. WILLIAM T. GELL, who was appointed master mechanic of the G.T.P. at Rivers, Man., in February, 1908, died at the home of his mother, in Stratford, Ont., on Thursday, September 9th. Mr. Gell was well known in railway circles.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## STREAM POLLUTION.

Each season brings its own problems. The wet season, drainage, the winter months, snow removal, the spring time, refuse cleaning, and the continued dry weather throughout many districts forces upon many municipalities consideration of the sewerage and sewage problem.

Streams that are usually large enough to dilute the sewage have become polluted, and in the immediate vicinity of the outlets of trunk sewers there is a considerable area of grossly polluted ground. The lake levels have dropped a foot or so, and the shore line in some localities is strewn with the waste from our sewers. In some cases our water supply has become contaminated to a dangerous degree.

All this brings our municipalities face to face with the question of installing sewage disposal works. Sooner or later it must come. Those municipalities that have the foresight and courage to undertake such works will effect great savings, for they will prevent the outbreak of epidemics in the town that cost far more than do properly installed refuse and sewage disposal works.

An outbreak of typhoid may be necessary before some people can see their whole duty—but it is a very expensive reminder.

## SEWAGE DISPOSAL.

### REMOVAL OF PUTRESCIBILITY*

### CHAPTER V.

**Contact Beds** (Continued).

In the previous chapter dealing with the subject of contact beds and their power to remove putrescibility from sewage, we have demonstrated that, (a) A contact bed is something more than a mere filter, a filter being generally understood to remove undissolved matters by the mechanical action of straining, whereas a contact bed has the power of retaining and absorbing not only undissolved matters, but also organic matters in solution which are incapable of being affected by the mere process of straining; (b) The dissolved organic matters are drawn from the sewage to the surface of the filtering material of the contact bed, which becomes coated with a gelatinous film of great absorbing and suction power, and that this absorption takes place during the period when the bed is full of sewage; (c) The final process of nitrification or oxidation of the absorbed organic matters takes place, only after the liquid has been withdrawn from the bed, and a supply of air is admitted to the pores of the filter.

A certain amount (but very little) decomposition of organic matter takes place with the production of carbon dioxide, analogous to the decomposition in a septic tank, during the period of contact. This form of decomposition which is sometimes called anaerobic is not the aim in contact bed treatment.

In order to maintain contact beds at equilibrium, it is obvious that the relations between the processes (b) and (c) must be closely studied. It is necessary to know the length of time necessary for contact, so that sufficient of the organic matters are absorbed to produce a non-putrescible effluent, and again it is necessary to know the length of time necessary for rest or aeration, so that ample opportunity is given for nitrification to take place with the absorption, and produce a numeralized effluent, capable of only absorbing further oxygen to the amount allowed in connection with non-putrescibility.

The above factors and their comparative relations depend largely upon the nature and strength of the sewage under treatment, and no absolute rules can be laid down. Further, the preliminary treatment adopted with reference to the renewal of solids, either by ordinary sedimentation, septic tank sedimentation, or chemical precipitation has a direct bearing upon the efficient working of contact beds.

For example, Dunbar found that with the Hamburg sewage, contact beds could be filled six times a day with fresh sewage without yielding an unsatisfactory effluent. Whereas they would only take septic sewage twice a day. (See Principals of Sewage Treatment, page 87.)

Absolute data for the proper working of contact beds can only be obtained by a close investigation of the particular plant in question. Any upsetting of the equilibrium soon makes itself evident to the works manager, caused either by over-dosing or insufficient aeration, as the bed becomes spongy and clogged and its water containing capacity falls to zero.

There exist, however, certain general data and laws, which in the above relation it will be well to give some detailed attention to.

It has been noted that during the period of contact, a septic action of decomposition takes place with the production of carbon dioxide. It is very probable that if this contact period is too prolonged, that this septic decomposition may have an inhibitive action on the nitrifying organisms contained in the absorptive film. Wollny, in relation to agricultural chemistry, demonstrates that the production of carbon dioxide is in proportion to the amount of organic compounds added to the soil, and that an accumulation of carbon dioxide has the eventual effect of stopping further decomposition even if oxygen is present. This anaerobic period of contact, which is an essential to the contact bed, is the chief objection to the process, and also provides the reason why the system is not so efficient as that of the percolating filter, which at no period provides anaerobic conditions.

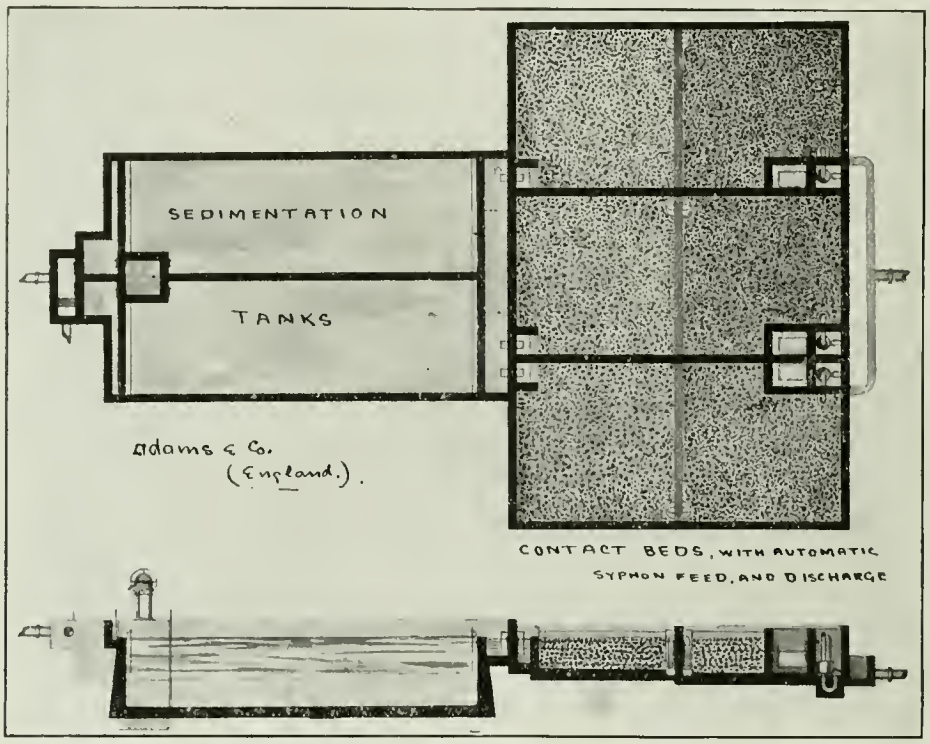
With reference to the period of contact the Royal Commission state (page 54, par. 106), "The evidence shows that two hours' contact and four hours' rest have generally been found to give the best results in practical working, where the beds are filled three times a day, but no rule can be laid down which is of universal application.

Dr. Fowler with reference to his Manchester (England) experience states as follows: "The periods depend almost entirely on the age of the bed and the dilution of the sewage. In the initial stages of working, long contacts (e. g., twenty-four hours) have been found advantageous, their effect being to facilitate the formatinon of a slimy layer of colloidal matter on the medium, in which the real biological action begins. As this layer increases, the absorptive effect increases also, and less time of contact is required. Moreover, a greater

*These articles are specially prepared for this Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

quantity of water is held up in a bed, and the quantity of draining increases, till with a bed in long use a very short contact, say, a quarter of an hour is all that is required. With increase in dilution of the tank effluent, due, e. g., to storm water, the period of contact may be reduced to a minimum. In general, after the bed is once mature, the period of rest is more important than the period of contact, and the total time occupied in twenty-four hours in filling, standing full, and emptying should not exceed the total of the period of rest. Thus, with ferquent fillings, the time of contact should be shortened. If the bed takes long to fill, the extra time in filling should be taken from the time of contact."

The above is quoted as it represents fairly accurately English practice, which has given great attention to the practical working of this system. Dunbar in his Hamburg experiments practically substantiates English practice in this




direction. In order to test the amount of purification effected and absorption at various periods of contact, six filters were constructed of exactly similar size and of the same material, and they were charged simultaneously every day with the same sewage. The first filter was discharged after standing full for half an hour, the second after an hour, and so on. The results are shown in the following table:—

Reduction in oxygen absorbed effected by Contact Bed.*

| | Time Bed Standing full (hours) | Oxygen absorbed (parts per 100,000) 1st. Day. | 2nd. Day. | 4th. Day. | Percentage Reduction in Oxygen abs'bed on 6th. Day. | 6th dy. |
|---|---|---|---|---|---|---|
| Crude sewage, str'ned | .... | 9.07 | 12.30 | 9.30 | 11.42 | ..... |
| Effluent from Bed | 1 | 0.5 | 5.85 | 4.10 | 4.37 | 3.57 | 68.73 |
| " " " | 2 | 1.0 | 3.52 | 3.67 | 4.07 | 3.15 | 72.43 |
| " " " | 3 | 2.0 | 3.22 | 3.07 | 2.62 | 2.27 | 80.09 |
| " " " | 4 | 4.0 | 2.87 | 2.77 | 2.47 | 2.00 | 82.49 |
| " " " | 5 | 6.0 | .... | 2.92 | 2.32 | 1.85 | 83.81 |
| " " " | 6 | 12.0 | 2.77 | 1.75 | 1.75 | 1.57 | 86.21 |

The table shows clearly that the reduction on the oxygen absorbed, which may be taken as a measure of the changes which have occurred is not so great on the first as on the following day. On the sixth day the filters were so far matured that they effected a considerable reduction in the oxygen absorbed. Even with only half an hour's contact the oxygen was reduced from 11.42 to 3.57, i. e., by 68.73 per cent., and the effluent was non-putrescible. By a longer contact the oxygen absorbed was further reduced, but not by any means at the same rate. The main portion of the purification had taken place, therefore, during the first half hour. The experiment was repeated, allowing the first filter to stand full of sewage for five minutes, the second for thirty minutes, and so on. The filters were now more mature, and within the first five minutes the oxygen absorbed was reduced from 13.87 to 2.34, i. e., by 83.2 per cent. The main portion of the purification had thus been achieved during the first five minutes. Dunbar, therefore, points out what must be apparent, that the separation of the putrescible matters in solution does not occur gradually, requiring prolonged periods of contact, as would be the case if it were due to the direct decomposing action of bacteria during the time of contact.

We must conclude that the time of contact or period when the beds stand full is useful only as far as the question of absorption is concerned, and that as the absorbing power of the filter increases, the time of contact may be cut down to minutes, and that no benefit in extra nitrification is obtained by allowing longer periods of contact than are necessary for the process of absorption.

Referring to the period of rest or aeration, which is generally now acknowledged as the most important phase in the contact cycle process. During this period, when the liquid sewage is drawn off, the bed uses up not only the oxygen which is immediately drawn into the pores of the filter taking the place of the space volume lately occupied by the liquid, but continues with great energy to attract oxygen from the surrounding atmosphere. This has led to many experiments with a view to forcing atmosphere into the filter beds under pressure, such, however, have not been successful in practice. It is agreed that a well constructed bed supplied with aerating pipes, the filtering material being of a size allowing ample air space, can obtain by ordinary methods all the oxygen it requires. It is a question, however, whether in the case of using very fine material, or where beds have to be protected from the frost, a greater efficiency can not be obtained by introducing warmed air into the base of the filter during winter months especially.

In the case of a very fine material especially when the beds are fairly deep, such as 6 feet for instance, the air containing space being proportionately small, the oxygen may be used up at a higher rate than it can be supplied. We have several examples of such beds on record, where undesirable septic decomposition has been set up, the effluents showing discoloration, caused by sulphide of iron, as well as giving off strong odors of sulphuretted hydrogen.

The main reason why a contact bed will deal with such large quantities of sewage, remains in the fact that the gen-

*Principals of Sewage Treatment, page 159 (English Edition.)

eral construction of the bed allows a complete aeration, whereas with soil the atmosphere has great difficulty in penetrating to depths of over 2 feet.

During the period of aeration, when nitrification is taking place, the contact bed is practically a breathing thing, taking in oxygen and expiring carbon dioxide. That this action is biological, there is practically no doubt. If a well matured bed be treated with chloroform or mercuric chloride, nitrification at once ceases, although for a time the film will continue to absorb oxygen and produce carbon dioxide, proving that this action is due to chemical causes and not to micro-organisms, or possible to a decomposition brought about by enzymes, as in the case of a septic tank.

Loss of capacity and clogging are the great drawbacks to contact beds. The Royal Commission (Fifth Report) give the following factors as chiefly responsible for failure:

(1) Disintegration of the filtering material.
(2) Consolidation of the filtering material.
(3) Deposition of colloidal matter.
(4) Growth of organisms.
(5) The volume of liquid passed on to the bed.
(6) Insufficient rest.
(7) Inefficient drainage.
(8) The amount of suspended matter passed on to the bed.

A very brief consideration of the above factors will convince anyone that they can all be guarded against by proper construction and careful working.

Nos. 1 and 2 may be taken together and they point to the necessity of choosing a filtering material which will not disintegrate either by contact with the liquid or by frost. The material must, primarily, be hard and insoluble, and of such a character and size that it will build itself up in the bed without crushing or settlement. Soft sandstones producing grit silt are useless, and the same may be said of certain soft and unwashed furnace clinkers, although well burnt hard furnace makes an ideal filtering material. Nos. 3 and 4 can be reduced by flushing and rest. Nos. 5, 6, 7 and 8 are all matters which should be primarily attended to in construction and design of the work.

With reference to the size of material, from 3/8th to 5/8th inch diameter is suitable for sewages from which about 60 per cent. of the original solids in suspension have been removed

## THE DURHAM MAIN SEWERAGE WORKS.*

By H. W. Taylor, A.M.Inst.C.E.

As is well known, the city of Durham is a very old town, and dates for many centuries back, and consequently the drainage and sewerage arrangements, such as they were, date from these times. The houses and streets were no doubt originally drained by old stone culverts and drains (many of which are in evidence to-day), discharging into the river.

The first attempt at systematically sewering the town was about the year 1853, when Mr. Hawkesley, of London, designed and carried out a system of what he termed "pot-pipe sewers," picking up the drains of the houses and discharging the sewage into the river at about 33 points.

The city of Durham is situated on both banks of the river Wear, this river having a very tortuous course through the city and dividing the town roughly into three parts—namely, the North-road and Western Hill districts in the west, the Cathedral, Claypath and Gilesgate district in the centre and north-east, and the Elvet district in the south-east

Generally speaking, the town slopes steeply to the river which is the natural outlet for the sewage. There are two dams across the river in its course through the city—namely, near Framwellgate Bridge and near Prebends Bridge. These dams impound the water, and consequently sewage matter remains in them for long times at a stretch, the only flushing possible being by means of floods. The fall in the river is not very great, and consequently the difficulty of drainage is thus increased when one bears in mind the very roundabout and tortuous course of the river.

**Original Scheme.**—The original scheme adopted by the Council about 1898 was to lay gravitating sewers following the course of the river on both sides to a point opposite Sands House, where the sewage was to be raised by large gas engines and centrifugal pumps from a pump well into chemical precipitation tanks. Thence the sewage was to pass through filters and ultimately over about 8 acres of land.

**Intercepting Sewers.**—It will be readily seen that with this system the gradients of the sewers were necessarily extremely flat, the flattest one having an inclination of about 1 in 872, while others were of 1 in 670 and 633. This was an important point in the drainage system, as these gradients necessarily were not self-cleansing and the Council feared deposit taking place in the pipes, which fear the author shared. The alternative of this was to bring the sewage from the Elvet district by means of a tunnel under Claypath to the Sands. Great difficulties and dangers were prophesied, and it was stated that if an attempt were made to drive this tunnel terribly bad ground would be encountered and the cost would be enormous. The Council, however, acting upon the advice of the engineer, had a series of boreholes sunk along the line of the intended tunnel which showed the ground to be very much better than the prophets foretold, with the result that the tunnel was successfully driven without incurring any exceptional trouble or expense.

The result of this tunnel is that the gradients of the sewers have been greatly improved, the flattest one being 1 in 300, as compared with 1 in 872, for the circuitous route following the river banks. It is also interesting to note that by this means one river crossing was avoided.

Some of the intercepting sewers had to be constructed upon piles in the river, and this was carried out in the following manner. Rolled steel joists were driven to a solid foundation, the soil was excavated to well below water level, the joist was then encased in a sanitary pipe filled with cement concrete. The result of this is that the work has been very satisfactorily done at a very reasonable cost. Flushing chambers are provided where necessary at the heads of the sewers, and a system of ventilation chiefly by shafts near the houses and ventilating manhole covers in the fields will be shortly installed.

**Scheme Finally Adopted.**—The disposal works finally adopted by the Council are as follows: The sewage upon arriving at the pump well will be raised by (a) small gas engines and centrifugal pumps dealing with the dry-weather flow, or (b) large gas engines and pumps dealing with the greatly increased flow in times of heavy rains into (c) detritus tanks, then passing through (d) storm overflows into (e) hydrolytic tank, thence through (f) rectangular percolating filters, the effluent from which will, by a series of carriers, gravitate over (g) about 12 acres of land, and, passing into the underdrains, will ultimately reach the river in a thoroughly purified state. The excess flows from the storm overflows will discharge respectively into the river and on to storm-water percolating filter-beds, so that the system of purification will be very thorough.

**Sewage Flow.**—The population of Durham has slowly increased during the past twenty or thirty years, but the chief increase took place at Western Hill. Up to 1906 this district was outside the boundaries of the borough, but since then the boundaries have been extended, and the population increased accordingly from about 14,000 up to 18,000. The system of sewers will easily convey the sewage from at least 30,000 population, while the sewage disposal wroks are designed for 18,000 population, but it should be noted that the system adopted is essentially elastic.

**Pumping Machinery.**—The pumping arrangements consist of two distinct sets of engines and pumps for dealing

*Paper read at the first annual general meeting of the Institution of Municipal Engineers.

with the dry-weather flow and storm flow respectively: The smaller set consists of 4 and 8 horse-power gas engines, driving centrifugal pumps, and designed to deal with the varying rate of flow, the larger engine and pump dealing with the day flow, and the smaller one with the night flow. These engines and pumps will be fixed in the small underground pumping station. The larger set consists of two 30 horse-power gas engines, driving centrifugal pumps, and designed to deal with the sewage flow during times of exceptional rains, under which conditions the sewage will probably exceed the dry-weather flow many times. (It should be noted that the system of sewers is on the "combined" system, that is to say, the sewage and storm-water discharge into the same system of pipes, although it is ultimately intended to exclude as much storm water as possible, where this is feasible).

**Detritus Tanks.**—The detritus tanks are of the deep Dortmund type, having conical bottoms. This is intentionally arranged so that the detritus can be discharged from the bottom of the tank by opening a valve without having to empty the tank, such as is necessary with the shallow type. The author considers the Dortmund type of detritus tank to be one of the most efficient at present known.

**Hydrolytic Tanks.**—The type of tank adopted is quite different from the ordinary hollow rectangular or septic tank. It will be built of ferro-concrete. It is a very great improvement on the septic tank, as it really separates the sludge from the liquid in a very much more efficient and satisfactory manner than has yet been obtained with any other kind of tank the author is aware of up to this date. The sewage passes through this tank, and in its passage it is freed of nearly all its solid matters and some portion of its colloids also. Valves are arranged in the bottom of the hydrolytic tank so that the sludge can be run off without emptying the tank, and this is a feature of the type. The tank is the subject of a patent.

**Percolating Filter.**—The sewage after leaving the hydrolytic tank will flow into a centre feed channel between two rectangular filters, over which it will be evenly distributed by means of rectangular distributors. These filters are provided with false floors so as to afford efficient aëration and drainage, and are filled with suitable media (preferably clinker) graded in size. The floors have a cross fall, and the effluent is collected in channels at the sides along which it runs to a sump at the lower end, where the humus passing out of the filters with the effluent will be caught.

**Land.**—The total area of the land purchased by the corporation consists of 19 acres. Of this the cottage, pumping station, cart road and other walks, tanks and filters occupy about 7 acres, leaving a net area for irrigation of about 12 acres. The ground has been divided into plots and levelled, the surface being formed into ridges and furrows. The land is, generally speaking, of a sandy loam, with little or no gravel, and clay was encountered in one or two places. Underdrains have been laid under the barrow paths and walks, into which the effluent will percolate, ultimately discharging into the river in a purified state through three outlets.

**Sludge Disposal**—The arrangement for disposing of the detritus from the detritus tanks and the sludge from the hydrolytic tank is by burial in the land. Trenches will be cut about 1 ft. or 15 in. deep in the land, into which sludge will gravitate. It will then be immediately covered over, and thus aërial nuisance is reduced to a minimum. The matters raised by the rakes from the screen in the pump well will also be dealt with in a similar manner.

**Storm-Water Filter.**—The storm-water filter is constructed in a somewhat similar way to the percolating filters, except that it is only 3 ft. deep, and the media is of larger size. The storm-water will be roughly distributed over its surface by means of half-pipes or wooden troughs. This filter is also provided with floor tiles to afford the necessary aëration and drainage.

**Cost.**—The estimated cost of the entire scheme, including land, disposal works, and intercepting sewers, is about $215,000, and it is expected that the works will be carried out for a little less than this amount.

## IMPROVEMENT NAVIGATION ASSOCIATION.

### The Great Lakes and St. Lawrence.

The Great Lakes and St. Lawrence Improvement Navigation Association, organized at Toronto on September 9th. They decided to wait on the Dominion Government at an early date to urge the advisability of deepening the Welland Canal. In the meantime a circular setting forth the necessity of the improvement will be printed and circulated among the various municipalities. The following officers were elected: —

President, H. W. Richardson, Kingston; Vice-presidents, H. Champ, Hamilton, Thomas Conlin, Thorold, Thomas L. Church, Toronto, Thomas King, K.C., Kingston, A. E. Kemp, Toronto, Mayor J. S. Campbell, St. Catharines, Colonel Ponton, Belleville, A. A. McKay, Hamilton, J. B. Miller, Toronto, L. L. Henderson, Montreal, Mayor L. H. Daniels, Prescott.

## NOVA SCOTIA SOCIETY OF ENGINEERS.*

The election of officers for 1909 resulted as follows:

President, S. Fenn; First Vice-President, J. A. Stairs; Second Vice-President, J. W. Mackenzie; Secretary, J. Lorne Allan; Council, Prof. R. R. Keeley, A. R. McClean, H. C. Burchell, D. McD. Campbell, J. G. McKenzie, A. G.. Robb, G. M. Archibald and W. G. Yorston.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

7881—August 27—Covering regulation adopted by the Board for the carriage of explosives by railways subject to its jurisdiction.

7882—August 24—Approving of change of location of the G. T. P. Railway from the East line of Section 1, Township 52, Range 24, West of 5th Meridian, District of North Alberta, Province of Alberta, mileage 43.56 to mileage 55.15.

7883—August 24—Approving location of G. T. P. branch line, Melville-Regina Branch, Section 31, Township 22, Range 6, to Section 13, Township 21, Range 12, West 2nd Meridian, mileage 0 to mileage 33, District of Assiniboia, Saskatchewan.

7884—August 24—Recommendation to the Governor in Council for approval of By-law of the Oshawa Railway Company in re-spitting and smoking on Railway premises.

7885—August 24—Recommendation to the Governor in Council for approval of By-law of the Thousand Islands Railway Company in re-spitting and smoking on railway premises.

7886—August 24—Authorizng the Alberta Government Telephones to erect wires across the tracks of the C.P.R. at Sullivan Street, Camrose, Alberta.

7887—August 25—Authorizing the City of Hamilton to erect lay water pipe under tracks of G.T.R. at the intersection of Hillyar Street and the Northern and North Western Branch of the Railway.

7888—August 27—Authorizing the Canadian Northern Ontario Railway to construct joint section of C.P.R. and C.N.O.R., Parry Sound Spur, under the tracks of the C.P.R. at Parry Sound, Ontario.

7889—August 27—Approving By-law of the New Brunswick Southern Railway Company authorizing H. W. Newnham

(Continued on Page 320).

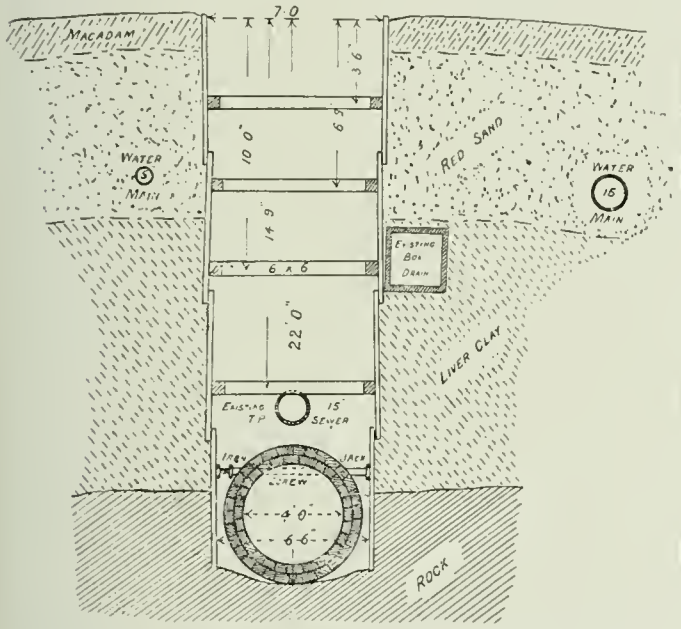
*Continued from page 279 Vol. XVIII.

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### COST OF BRICK SEWER.*

On the 26th June, 1908, work was commenced on the construction of the Kent St. Relief Sewer, and which was carried out by the city (day labor). Starting at a point on the Ottawa River, it extends in a southerly direction. This sewer is for the purpose of relieving a system of small tile pipe sewers and a 2' 8" x 4' Brick sewer, which becomes badly surcharged after every rain storm, in the vicinity of Laurier Ave. W. From the outlet on the Ottawa River to the 6 foot by 6 foot inspection chamber at the top of the cliff the sewer is of steel pipe, 24 inches in diameter, in six sections flanged and bolted together. The total length is 146 feet 6 inches, on a 70 per cent. grade, and the last two pipes at the flanges are bedded on a rock foundation in a mass of concrete 7 ft. by 9 feet by 3 feet 9 inches. From the inspection chamber the sewer is circular, 48 inches in diameter, and built of brick 8 inches in thickness. The brick sewer is constructed in open cut throughout, and the trench is directly on the line of the old 15 inch tile pipe sewer. At first, considerable difficulty was experienced in getting rid of the water from the old tile pipe, for the purpose of keeping the




trench dry in the drilling of the rock-bed and the building of the brickwork. A 5-inch electric centrifugal pump was used, but proved expensive, and unsatisfactory for moving, as the work proceeded. Finally, iron troughs were substituted, connecting the old work and the new, and found of great service, as they were light, not bulky, of sufficient carrying capacity, and allowed the workmen perfect freedom to carry on their duties. At the inspection chamber the sewer has a rise of 2 ft. with a ramp, after which there is a grade of 0.291% till Vittoria St. is reached, and another rise of 3.44 feet is made with a ramp. From this point to north building line of Wellington St. the grade is much steeper at 2.05% until it again changes back to 0.291% and Queen St. is reached. From Cliff St. to Wellington St. the rock averaged 9 feet deep and was of a hard, tough nature. The Ingersoll-Sergeant steam drill has been used all the time, with steam at 90 lbs. pressure, supplied from the boiler of the traveller, and has given very satisfactory results. Very great care had to be taken with the timbering of the trench, which was close sheeted in two to four settings, all through from roadway level to rock level. The strata above the rock were of a varying nature, from red sand to hard pan and liverclay, while between Wellington and Sparks St. the strata were particularly bad, for under the liverclay was a bed of pure running sand. Work was carried on by two gangs working day and night until the crossing was made. A 5-inch water main on the one side, a 15-inch on the other, gas and Bell Telephone cables and an old 30-inch box drain to make the work of construction difficult. In the blasting of the rock, care had also to be taken on account of the danger of vibration and concussion to the surrounding property, including St. Andrews Presbyterian Church, the British American Bank Note Co. and other buildings, with the possibility of a cave-in of the whole sewer trench, which at this section is 22 feet deep. (See diagram.) It is a matter for congratulation that the work was caried out in winter and not in summer, otherwise there would be more serious danger. In winter the liverclay and running sand were in a frozen state, and so until tampered with and exposed to the atmosphere has some stability of its own. The traveller which weighs about 2 tons was carried directly over the bench on rails 7 ft. 6 inches gauge, and handles all the material expeditiously in buckets holding ⅔ of a cubic yard. Construction is proceeding as fast as it is possible to proceed with under the circumstances, and in the face of the peculiar difficulties that have presented themselves as far as is consistent with good workmanship and public safety. The length of the sewer constucted, for the estimate, was 860 feet or 0.16 miles, and the cost of construction $18,097.41.

*Adapted from a report of W. H. Carson, C. E., to Mr. N. J. Ker, City Engineer, Ottawa.

The detail cost of the 48-inch brick circular sewer is as follows:—

| | Actual Cost per foot. | Estimated Cost per foot. |
|---|---|---|
| Brickwork | $1.93 | |
| Bricklaying | 1.66 | |
| Sand | 0.23 | |
| Cement | 0.72 | |
| | $4.54 | $4.95 |

### FAIR RATES OF RENTAL FOR MACHINERY ON MUNICIPAL WORK.

In their recently published report to the Boston Finance Commission, Metcalf & Eddy, of Boston, consulting civil engineers, discuss in some detail the fair rates of rental for machinery on municipal work, particularly with relation to conditions heretofore existing in the Sewer Department of Boston, when over $32,000 was paid in machinery rentals during a period of nineteen months.

It was found that the prices paid for such rentals were very much higher than the market prices and than were reasonable. Had the city rented its machinery at a monthly rate of 5 per cent. of the first cost of the machinery, a material saving would have been effected. If the city should continue to do work by day labor, which the engineers do not recommend, however, they indicate that it would seem wise for it to purchase and own its machinery, in which case the rental, including interest, would be materially less than 5 per cent. per month. During the period of nineteen months nearly enough money was paid for rentals to pay the first cost of an equipment sufficient to meet the requirements of the department.

"It is somewhat difficult," so state the engineers, "to determine what is a fair rental for machinery upon this class of work. It not infrequently happens that much machinery is abused by those operating it, and it is also at times injured when being moved, and in cold weather it is liable to be damaged by freezing of water in pipes and boilers. The owner must take all of these conditions into consideration in fixing his price. There are, however, a few firms which make a business of building and renting ma-

chines, and in fixing the fair rental prices herein presented, the charges made by some of these companies have been taken into consideration. In view of all the circumstances, it does not appear that a rental amounting to 5 per cent. of the first cost of the machine for each month's use is unreasonable, although at first glance it appears to be very high.

For purposes of comparison in this report Metcalf & Eddy used the cost of new machinery, as given in the accompanying table, and calculated the fair rental per month on a basis of 5 per cent. of first cost as given therein:—

**Cost Prices of Machinery Rented by Sewer Department.**

| | Cost | Fair rental per month |
|---|---|---|
| Six-bucket Carson trench machine, including engine delivered on street and erected | $3,300 | $165.00 |
| Carson cable machine, including 30 horse-power reversible, link motion engine, delivered and erected upon the street.... | 3,250 | 162.50 |
| Hoisting engine and boiler, 20 horse-power (Bond) $1,656, less 30 per cent. (including swinging gear) ..... | 1,200 | 60.00 |
| Fifty-foot boom derrick, fully equipped, ready to run, with bull wheel (Bond) exclusive of engine ..... | 500 | 25.00 |
| Tubs and buckets, 12 cubic feet, No. 6,536, D. F. & M. Company (Bond) 50 per cent. discount ..... | 28 | 1.40 |
| Scale boxes, ½ yard, 12 cubic feet, No. 6,518 D. F. & M. Company (Bond) 30 per cent. discount ..... | 98 | 4.90 |
| Portable boiler for pumping engine..... | 450 | 22.50 |
| Pumping engine without boiler and pump.. | 275 | 13.75 |
| Six-inch centrifugal pump, with extra pipe, hose, strainer, etc. ..... | 350 | 17.50 |
| Four-inch pulsometer and fittings ..... | 350 | 17.50 |

## COST OF WATER POWER PLANT.

The accompanying table of estimated costs per horse-power of water power plants was prepared by Charles T. Main, mill engineer and architect, Boston, Mass., and gives approximate figures for ordinary conditions and should be useful in making rough preliminary estimates. It is to be noted that the costs of dam, canal, and buildings are not included for these of necessity will vary greatly with the locality.

TABLE OF ESTIMATED COSTS PER HORSE-POWER OF WATER POWER PLANTS.

Having Horizontal Turbines, Steel Penstocks, and Walled Tailraces—Dam and Buildings not included.

| | "L." | 10ft. fall | 20ft. fall | 30ft. fall | 40ft. fall |
|---|---|---|---|---|---|
| | 200 feet | $71.91 | $32.84 | $21.70 | $16.38 |
| 1,[illegible] h.p. | 400 " | 85.43 | 39.77 | 26.32 | 19.35 |
| | 600 " | 93.96 | 46.60 | 30.94 | 23.53 |
| | 200 " | 72.22 | 33.12 | 21.98 | 16.78 |
| [illegible] h.p. | 400 " | 85.70 | 40.04 | 26.56 | 20.35 |
| | 600 " | 90.15 | 46.98 | 31.17 | 23.93 |
| | 200 " | 72.64 | 33.49 | 22.34 | 17.20 |
| 600 h.p. | 400 " | 86.20 | 40.45 | 26.95 | 20.87 |
| | 600 " | 99.76 | 47.42 | 31.57 | 24.54 |
| | 200 " | 73.16 | 34.05 | 23.10 | 17.82 |
| 400 h.p. | 400 " | 86.90 | 41.03 | 27.73 | 21.45 |
| | 600 " | 100.65 | 48.03 | 32.35 | 25.08 |
| | 200 " | 75.35 | 35.07 | 24.07 | 19.47 |
| 200 h.p. | 400 " | 89.10 | 43.56 | 29.70 | 23.21 |
| | 600 " | 102.85 | 50.60 | 34.43 | 26.95 |

## STREET SPRINKLING.

The mileage of streets sprinkled in Ottawa during 1908 was 52.42, and the average cost per mile was $353.23.

## COST OF CEMENT WALKS AND CURBS IN HAMILTON, ONTARIO, 1908.

| | Length lin. ft. | Area sq. ft. | Total cost. | Cost per sq. ft. |
|---|---|---|---|---|
| Cement walks. | 42,568 | 263,080 | $37,035.16 | 14 1-10c |
| Cement curbs. | 569 | ..... | 253.73 | 44 5-10 per lin. ft |

## COST OF SNOW CLEANING.

During 1908 Ottawa paid for snow cleaning as follows: For 140.52 miles of street $20,432.34 or 145.40 per mile. Adding 759.37 for plant, repairs, etc., it cost $150.81 per mile.

The snow fall during that period amounted to 115 inches and the work was done by day labor.

## RAILWAY ORDERS.

(Continued from Page 318).

to prepare and issue tariffs of tolls to be charged for freight traffic on its line of railway.

7890—August 27—Approving By-law of the New Brunswick Southern Railway Company authorizing Hugh H. McLean to prepare and issue tariffs of tolls for all passenger traffic on its line of railway.

7891—August 27—Authorizing the Bell Telephone Company to erect its wires across the tracks of the Michigan Central Railway at public crossing 1¼ miles west of Welland, Ontario.

7892—August 27—Authorizing the Condie Rural Telephone Company to erect wires across the tracks of the Canadian Northern Railway in north half of Section 30, Township 18, Range 20, West of 2nd Meridan, Saskatchewan.

7893—August 27—Authorizing the Government of the Province of Alberta to erect wires across the tracks of the C.P.R. at Dominion Avenue, Frank, Alberta.

7894—August 27—Authorizing the Rural Municipality of Pipestone, Manitoba, to erect wires across tracks of the C.P.R. at public crossing one-quarter of a mile west of Sinclair, Manitoba.

7895—August 27—Authorizing the Rural Municipality of Branda, Manitoba, to erect wires across the tracks of the C.P.R. at public crossing 300 feet north-east of Napinka Station, Manitoba.

7896—August 27—Authorizing the Manitoba Government Telephones under Section 246, to erect wires across the tracks of the C.P.R. at Strathclair, Manitoba.

7897—August 10—Dismissing complaint of the Plymouth Cordage Company, North Plymouth, Mass., in re-rates on binder twine: and authorizing the Michigan Central Railroad Company to refund to the Plymouth Cordage Company the sum of two cents per 100 pounds in respect of the four carloads of binder twine shipped by the Plymouth Cordage Company to Wallaceburg, Dresden and Wheatley, making a difference between the legal rate of 18c. per 100 pounds and the rate of 20c. per 100 pounds charged and collected by the Railway Company on said shipments.

7898—August 27—Approving of the proposed deviation of the Hamilton, Waterloo and Guelph Railway from the Village of Sheffield to and into the Town of Galt, Ontario.

7899—August 30—Extending until the 25th day of September 1909, the time in which the City of Montreal shall put in proper repair the bridge known as Bridge No. 1.65, being a steel viaduct carrying St. Catharine Street over the track of the C.P.R. and ordering that the City of Montreal be liable to a penalty of $25.00, per day, for every day after September 25th, 1909, that the work required to be done shall remain uncompleted.

7900—August 27—Granting leave to the Tilbury Telephone Company to place its wires across the track of the

(Continued on Page 328).

## GREAT ENGINEERING WORKS ON THE CANADIAN PACIFIC RAILWAY.*

By J. E. Schwitzer, Assistant Chief Engineer, Western Lines.

### The Huge Lethbridge Viaduct in Southern Alberta and the Grade Reduction in the Canadian Rockies.

Two great engineering triumphs have been achieved this year by the Canadian Pacific Railway Company, in the construction of a huge viaduct on its Crow's Nest branch, and the reduction of the steep grade in the Canadian Rockies. Both are works of considerable magnitude, and both have been successfully completed in a remarkably short time. Although only separated by less than 200 miles as the crow flies, these engineering feats are essentially different in every aspect, even in their surroundings and conditions, the one being located in mountain recesses, and the other on the broad planes of a ranching and grain-growing region.

### The Lethbridge Viaduct.

The Crow's Nest line of the Canadian Pacific Railway branches off the main transcontinental road at Medicine Hat, and parallels it through the mountains a hundred miles to the south, to give easy access from the east to the rich mining regions of southern British Columbia.

General.—The present line between Lethbridge Junction and MacLeod is 37 miles in length, the distance from Lethbridge, which is situated on a spur track, to Lethbridge Junction is 1.5 miles. The total distance from Lethbridge to MacLeod being 38.5 miles. The present line is constructed with curves as sharp as 7 deg. (819 feet radius) and with a grade of actual 1 per cent. (52.8 feet per mile), no compensation being allowed for curvature, so that in the estimates for new location the ruling gradient on this line was calculated to be equal to a virtual 1.2 per cent. grade (63.4 feet per mile).

On the above line, which was constructed in 1897 and 1898, are the following wooden deck bridges:—

| Bridge | Length | Height from Ground to Base of Rail |
|---|---|---|
| 108.7 | 406 | 110 |
| 112.2 | 476 | 105 |
| 112.4 | 420 | 94 |
| 112.8 | 463 | 87 |
| 113.1 | 674 | 67 |
| 113.5 | 503 | 102 |
| 113.8 | 405 | 77 |
| 114 | 569 | 84 |
| 114.3 | 569 | 74 |
| 114.8 | 473 | 62 |
| 115.2 | 317 | 41 |
| 115.6 | 419 | 39 |
| 116 | 2933 | 65 |
| 117.5 | 707 | 117 |
| 119.6 | 449 | 73 |
| 120 | 567 | 117 |
| 120.2 | 313 | 53 |
| 121.1 | 629 | 113 |
| 131.8 | 755 | 24 |
| 132.5 | 16 | 9 |

A total of twenty bridges, with a total length of 12,063 feet, or 2.8 miles, 1,450 feet of this length being Howe truss spans, varying in length from 100 feet to 150 feet. In the majority of cases these bridges cross streams and ravines with very steep-cut banks, which, on account of the nature of the soil, require constant watching, especially in the spring and during high water. The worst of these crossings are those at St. Mary's and Belly Rivers.

On account of the life of these bridges being very nearly expired, they would require, during the present year, heavy repairs, or practically rebuilding. The estimated cost of permanent bridges to replace these wooden bridges is $1,065,000. Owing to the necessity of rebuilding these bridges, and to the rapid increase of traffic, and the fact that the original charter for the Crow's Nest branch required the construction of a line to start from Lethbridge, it was therefore decided to have surveys made and ascertain if it were possible to secure a low grade line with better alignment. With this object in view extensive surveys were made in 1904 and 1905, the line which was finally adopted being as shown on small scale plan attached, marked "A." This line gives a maximum virtual grade of four tenths of 1 per cent. (21.12 feet per mile) with a maximum curvature of 3 degrees(1,910 feet radius).

As already noted, the town of Lethbridge is on a spur track of the Crow's Nest Pass Railway, 1.5 miles long, which necessitates practically all trains running into Lethbridge and backing out, being a loss of three miles, which will be saved when the new line is placed in operation.

The saving effected by the new location as compared with the old is as follows:

5.26 miles of line, 1,735 degrees less curvature, thirty-seven fewer curves, and 401.5 feet less rise and fall, besides securing the 0.4 per cent. grade, as compared with a virtual 1.2 per cent. on the old line. These changes should so reduce operating expenses that the saving with an increase of 20 per cent. in traffic above what it was last year would pay an interest at the rate of 4 per cent. on an investment of $3,625,000, besides which it would cost to replace the old bridges with permanent structures $1,065,000. The total capital expenditure which would therefore be justified would be $4,690,000, while the estimated cost of the change of the line is $2,048,700. On this new line there are only two bridges, both large viaducts, one over the Belly River at Lethbridge, 5,327.6 feet in length, with a maximum height of 314 feet from the bed of the river. This viaduct is the subject of this article. The second bridge over the Old Man River, is 1,900 feet in length and 146 feet in height from the bed of the river.

Location.—The east end of the viaduct is 3,800 feet west of Lethbridge Station, being somewhat west of the centre of the town. Lethbridge is the centre of a large irrigation track and of an important coal-mining district, is a divisional point of the Crow's Nest branch of the Canadian Pacific Railway and the Alberta Railway and Irrigation Company, and has at the present time a population of about six thousand. It is located in the Province of Alberta, 759 miles west of Winnipeg, 2,174 miles west of Montreal, and is the centre of a rapidly developing territory.

Site.—The site of the bridge is the best for a high-level crossing in the immediate vicinity of the town. The slopes are fairly uniform for a distance of 1,000 feet from the prairie level, then drop more abruptly for 800 feet to the flat, which is flooded in extreme high water, then runs on an approximate level for a distance of 1,800 feet to the edge of the river, which is 300 feet wide. On the west side of the river it rises rapidly to prairie level in a distance of 1,300 feet.

On the east bank the soil is clay and gravel for about 6 feet from the surface, then 50 feet of hard clay, 12 feet to 20 feet of coarse gravel, and below this shale and coal.

In the bed of the river there is about 20 feet of gravel, then 20 feet of coal-shale, below that 2 feet of blue clay, then a hard shale for a distance of 16 feet to 18 feet, below which is hardpan and sandstone. The west side is of somewhat similar formation, but the bank has been eroded, causing it to cave in at several points, which makes it necessary to do extensive work in order to secure proper foundations for the bridge.

The alignment of the bridge is a tangent throughout, there being a 1 deg. curve at the east approach of the bridge, and a 3 deg. curve at the west approach; the grade is 0.4 per cent. rising to the west for the whole length of the bridge.

On the east side of the bridge there are some old mine workings which follow a vein of coal 7 feet thick which was worked out in 1888 to 1890. This vein of coal was practically horizontal and level with the flat at the river, varying

* Paper read at the British Association for the Advancement of Science, Winnipeg, Man., 1909.

Fig 1. GENERAL ELEVATION.

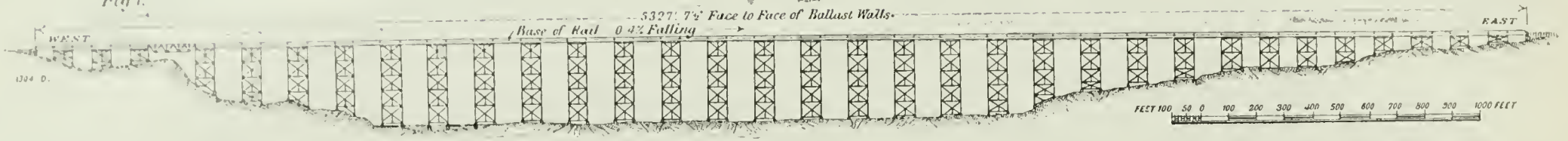

5327' 7½" Face to Face of Ballast Walls.
Base of Rail 0.4% Falling
WEST
EAST
1304 D.
FEET 100 50 0 100 200 300 400 500 600 700 800 900 1000 FEET

Fig. 2. HALF ELEVATION OF 100 Ft GIRDER

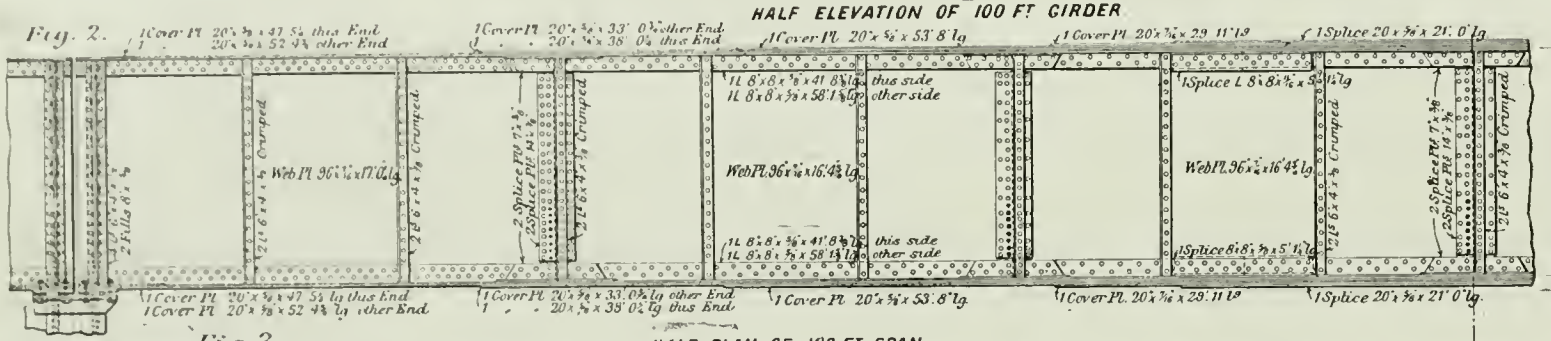
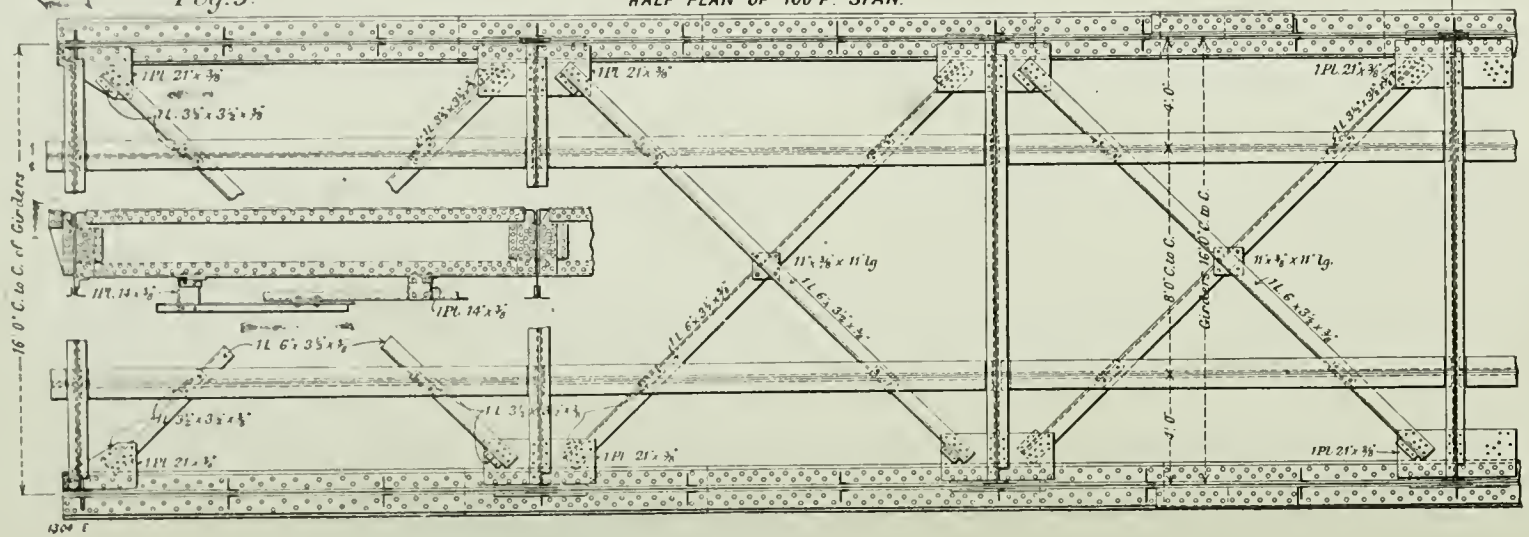
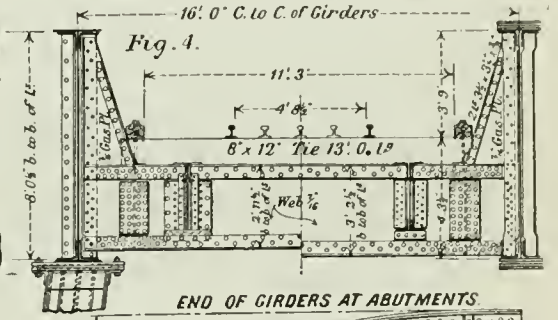

1 Cover Pl. 20"x ⅜"x 47' 5½" lg thus End
1 " " 20"x ⅜"x 52' 4⅜" lg other End
1 Cover Pl. 20"x ⅜"x 33' 0⅜" lg other End
1 " " 20"x ⅜"x 38' 0¾" lg thus End
1 Cover Pl. 20"x ⅝"x 53' 8" lg
1 Cover Pl. 20"x ⅞"x 29' 11" lg
1 Splice 20"x ⅜"x 21' 0" lg
2 Angles 6"x 4"x ⅜" Crimped
Web Pl. 96"x ⅜"x 77' 0" lg
2 Splice Pls 14"x ⅜"
2 Fills 6"x 4"x ⅜"
2 Splice Pls 14"x ⅜"
2 Angles 6"x 4"x ⅜" Crimped
1 L 8"x 8"x ⅞"x 41' 8½" lg thus side
1 L 8"x 8"x ⅞"x 58' 1½" lg other side
Web Pl. 96"x ⅜"x 16' 4½" lg
1 L 8"x 8"x ⅞"x 41' 8½" lg this side
1 L 8"x 8"x ⅞"x 58' 1½" lg other side
1 Splice L 8"x 8"x ⅞"x 5' 11" lg
1 Splice 8"x 8"x ⅞"x 5' 11" lg
2 Splice Pls 14"x ⅜"
2 Splice Pls 14"x ⅜"
2 Angles 6"x 4"x ⅜" Crimped
2 Angles 6"x 4"x ⅜" Crimped
1 Cover Pl. 20"x ⅜"x 47' 5½" lg thus End
1 " " 20"x ⅜"x 52' 4⅜" lg other End
1 Cover Pl. 20"x ⅜"x 33' 0⅜" lg other End
1 " " 20"x ⅜"x 38' 0¾" lg thus End
1 Cover Pl. 20"x ⅝"x 53' 8" lg
1 Cover Pl. 20"x ⅞"x 29' 11" lg
1 Splice 20"x ⅜"x 21' 0" lg

Fig. 3. HALF PLAN OF 100 Ft SPAN.




HALF END FLOOR BEAM. HALF INTERMED FLOOR BEAM

Fig. 4.




END OF GIRDERS AT ABUTMENTS

Fig. 5.

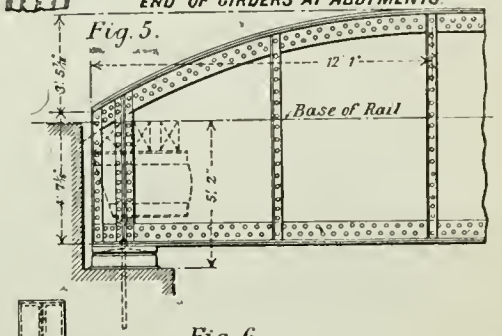
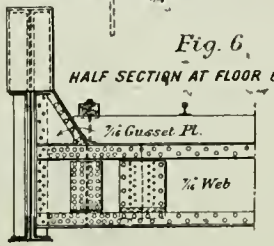



Fig. 6.

HALF SECTION AT FLOOR BEAM.



from about 25 feet at bent No. 23 to 150 feet below the surface at the east end of the bridge.

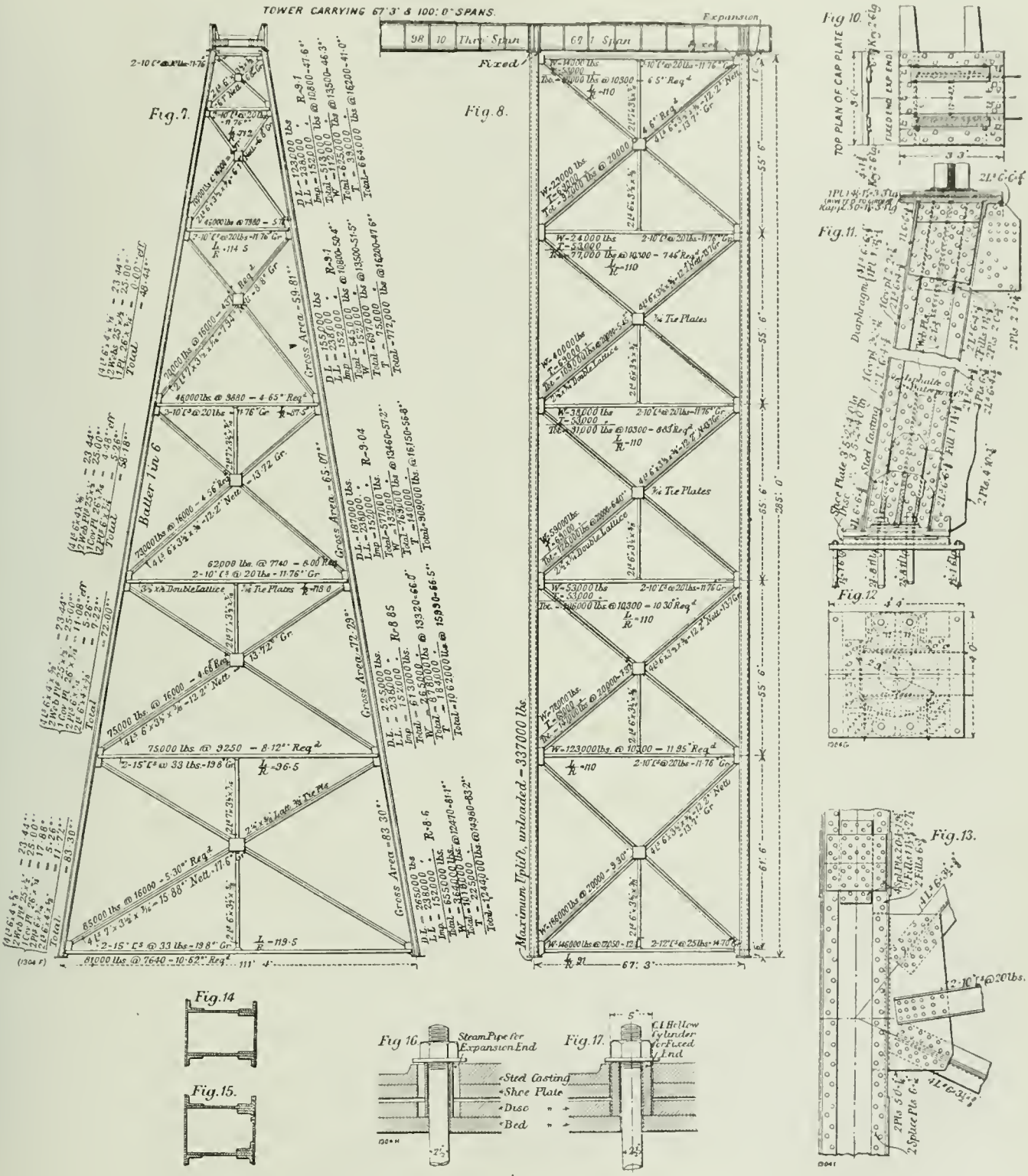
The work of finally laying out the centre line and locating the position of the pedestals for the viaduct was commenced during the first week of December, 1907.

Excavation.—The contract for the excavation and substructure of the bridge was awarded to J. Gunn & Sons, of the City of Winnipeg, the work to be completed by March 1, 1908. The excavation work was started in October, 1907, and the concreting was commenced in November, 1907, and carried on continuously, being completed in February, 1909.

Before excavation was started borings were made at various points along the bridge site; results of these are shown in the profile which is marked "B" hereto attached. In addition to this several test-pits were sunk and test-piles were driven. These several test-piles consisted of fir piles about 11 inches in diameter, and were driven to a depth of 24 feet to refusal, and were afterwards loaded with a 30-ton load and showed no settlement.

In order to make absolutely sure of the foundations near pier 23 a shaft was sunk to the old mine workings. In the sinking of this shaft we met with a couple of fatalities by men going in and being overcome with the accumulation of gas. They went down to rescue a small boy who was playing in the shaft after being repeatedly warned not to go near the place.

Considerable difficulty was experienced with the river piers, as it was found necessary to go down through the gravel and shale, making it very difficult to get tight cofferdams. In June, 1908, before the excavation for these piers was completed, there was a flood, during which the water rose to a higher level than had ever been known at this point, being 1 foot higher than previous extreme high water, which occurred in June, 1902. These levels are shown on the profile attached, which is marked C. This high water completely submerged the cofferdam, carrying enough silt to fill them, besides which it carried away some of the contractors' plant, causing delay in the completion of the work.



All the pedestals and foundations on the land were completed by August 31, 1908.

Foundations.—For the foundations of the bridge various estimates were made in connection with the cost of timber piles with concrete pedestals and concrete piles, with the concrete pedestals on top. It was finally decided to adopt concrete piles and concrete pedestals, and a contract was let on this basis. All the land piers, with the exception of six, were built on concrete piles, the excavation for the same averaging 7 feet deep, but in some cases running as deep as 18 feet. The length of the concrete piles varied from 12 feet to 20 feet.

The greater part of the concrete for piers was mixed with a three-quarter yard Smith mixer, and conveyed from the mixer to the piers in ordinary contractors' iron dump-cars.

The general formation of the river-bed is gravel over hard shale, there being an average of 10 feet of water, then 10 feet of gravel. On account of the hard formation of the river-bed no piles were used, the excavation for the piers was made with clam-shell buckets before the caissons were placed. The caissons were made of 10-inch by 10-inch material, and were floated into place and sunk; sheet-piling made of three pieces 2 inch by 10 inch nailed together to form tongue and groove was driven outside caisson, a second row of sheet-piling being driven about 3 feet outside the first to leave space for puddle. These caissons were pumped out with some difficulty, and the excavation finished with pick and shovel, the material being raised by bucket and derrick. Three centrifugal pumps were required to keep the foundations dry, excavations were made to hard shale, and drillings made to a further depth of at least 20 feet to make sure there was no change of formation. In three of the piers it was found that the pumps could not hold the water down long enough to erect the forms, and it was therefore necessary to have the bottoms carefully cleaned by divers before concrete was deposited; 4 feet of concrete was placed in the bottom, the full size of the caisson, and allowed to set. The caisson was then pumped out and the balance of the pier finished as usual.

On account of the steep side hill special pile-drivers had to be made for driving concrete piles.

Owing to the nature of the west slope all foundations were carried down to such a depth that if the ground takes a natural slope, the foundations will be well below it, besides which the ground in the immediate vicinity of the piers was sloped as shown on the profile marked "B" attached.

In addition to this, in order to keep water away from the west bank a reinforced-concrete retaining wall has been built, a sketch of which is shown on the plan marked "B," this concrete wall is built strong enough to withstand the pressure of saturated quicksand. This was adopted altogether as a precautionary measure. In addition to this piles were driven up-stream from the piers on the flat to catch any drift wood which might come down in the flood and lodge in the steel-work, and it is further intended that booms will be anchored up-stream in the river which will deflect any débris through the 100-feet openings.

Details of Design.—Numerous preliminary studies were made in connection with this structure, and the design finally decided upon consists of forty-four plate girder spans 67 feet 1 inch long, twenty-two plate girder spans 98 feet 10 inches long, and one riveted deck lattice truss span 167 feet long, carried on thirty-three rigidly braced riveted steel towers. The distance centre to centre of towers in each column was made 67 feet 3 inches, and the distance centre to centre of columns in adjacent towers 100 feet. The tower spans were made 67 feet long, in order to give longitudinal stiffness to the towers, and reduce stresses in the tower legs. A batter of 1 in 6 was given to the legs, which, with the spacing of the girders of the spans at 16-feet centres, gives ample spread at the base of the towers to keep the uplift at the piers within a reasonable amount; 100-feet intermediate spans between towers were decided on for that portion of the structure over 125 feet high, these spans being the longest thought feasible to handle, from an erection standpoint, although theoretical economy would call for still longer intermediate spans. On account of the severe winds experienced in this region, and considering the great height of the structure, it was decided to use through plate girder spans instead of decks on this viaduct, so as to render it practically impossible for cars to leave the deck from derailment or wind, and give greater security to the viaduct, since a derailed car might fall and knock out tower legs and bracing, on account of the great batter of the bents, and cause great delay to traffic. This type of span has since been adopted for a similar high viaduct in New Brunswick.

In order to take care of the uplift from wind the columns were securely anchored to piers by means of four 2½-inch diameter bolts built into the piers to such a depth as to engage a mass of masonry weighing 1½ times the uplift. Special steel castings were designed to secure the bases of these columns to the anchor-bolts, and between the shoe-plate and bed-plate the Canadian Pacific Railway standard disc-bearing was used, so as to provide for proper bearing in the event of the masonry not being absolutely level. Contraction at the base of the towers was taken care of by fixing one corner and allowing the other three corners to slide on the bed-plates. This was arranged by making 5-inch holes in the steel casting, shoe and disc-plates. At the fixed corner a hollow cast-iron cylinder was placed around the bolt, filling up the hole. At the other three corners, where movement takes place, a piece of steam-pipe was placed around the bolts, having a length of about ⅛ inch greater than the distance from the top of the bed-plate to the top of the steel casting, so as to allow the washer of the anchor-bolt to bear tight on this filler, which, in turn, bears on the bed-plate, and allows sufficient slack between the underside of the washer-plate and the steel casting for the latter to move. Dry graphite was placed in the recess of the bed-plates in which the disc-plates rested, to act as a lubricant. Tongues were made on the bed-plates at two corners of the towers, and the fourth bed-plate was made without any tongue, with the idea of its moving in a diagonal direction. Details of this arrangement are shown on the blue-prints of typical details, Nos. 36,542$_1$ and 36,542$_2$ attached. On the latter drawing typical details are also shown of the 100-feet plate-girder spans, as well as a stress-sheet and material diagram of one of the towers, the live-load diagram to which the bridge was designed, and a general small-scale elevation of the bridge.

At the western end of the bridge a high cut bank of hard clay had to be crossed, and although this bank was cut down to a slope of 1½ to 1, it was considered inadvisable to place pedestals on this bank, and it therefore became necessary to span this with a deck lattice truss span 167 feet long. The top chords of this span had to be built of special design in order to carry the heavy erection traveller, which will be referred to later on, and to give the effect of through plate-girders as viewed from the bridge floor; the bottom of these chords being at rail-level, while the top is flush with the top flanges of adjacent plate-girder spans.

As will be seen from the sheet of typical details, the columns are of very liberal dimensions, the bottom sections being composed of six angles, two web-plates 25 inches wide, one cover-plate 26 inches wide, in addition to two 6-inch plates placed in the inside of the columns. Longitudinal and transverse bracing is composed of angles laced together, the diagonal bracing being figured for tension only, and struts composed of channels placed back to back and latticed, are used to take compression stresses. Long struts are supported in the centre.

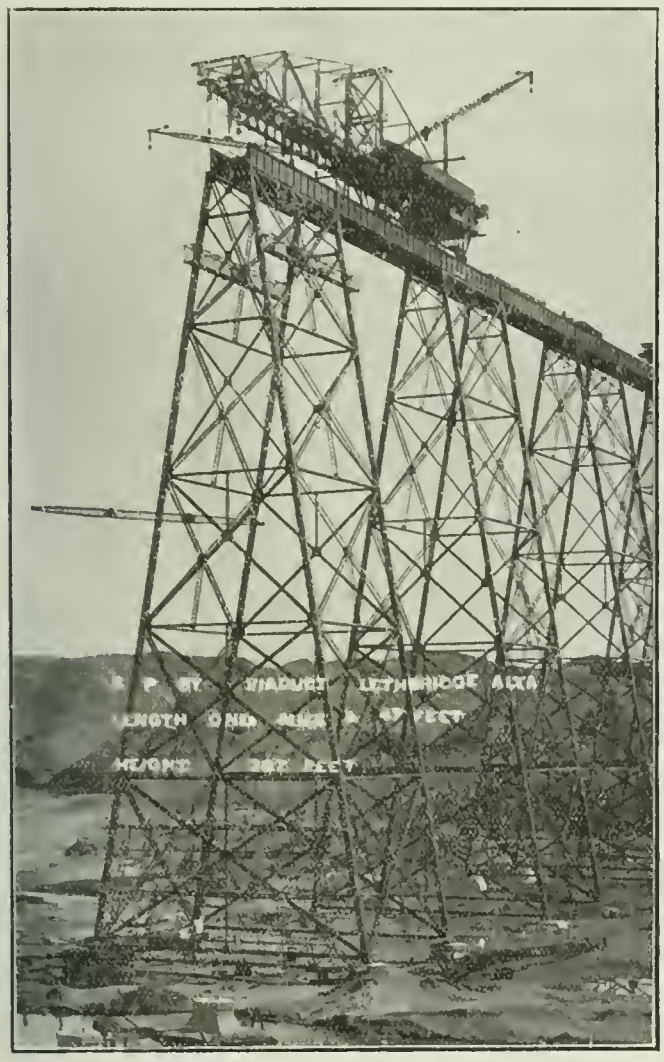
The use of double triangular type of bracing (without the horizontal struts) was considered, but was not used because of the great length of compression diagonals.

Details are also shown of the bearing of the spans on column caps, consisting of steel keys set in slots in the cap of the column and riveted to the girder shoe. In the fixed end the key is a neat fit in the groove of the column cap, but in the expansion end the key is made narrow so as to provide clearance on either side for movement of key in the slot. The underside of these keys is bevelled at the edges

to provide against their binding in the cap-plates. Details are also shown of the shore end of the flanking spans which show how the top flanges are curved.

### Erection.

Unloading Traveller.—A material yard was located a short distance east of the eastern end of the bridge, over which was erected a travelling crane, consisting of a standard 125 feet highway span, provided with end wheels, two of which at each end are connected up by gearing and shaft-



ing to standard two-drum hoisting-engine, thus providing for its travelling along the runway. Each end of the crane is provided with a 5-ton 42-foot boom derrick commanding the additional storage area of 40 feet wide by the length of the runway for the storage of lighter class of material, the main area between the crane and the runways being utilized for the storage of girders and heavy columns. The length of the crane runway is 240 feet, and the height 37½ feet.

For lifting 100-feet girders, which weigh about 30 tons each, two sets of three-sheave steel blocks rigged with ⅝-inch line were provided, with a capacity of 17 tons each, connected up to a standard double-drum hoisting-engine. Turning of the 100-feet girders end for end is provided for by hooks and beams arranged to swivel on the centre floor beam of a 125-foot crane, such arrangement being desirable in the event of girders reaching the work wrong end first.

For the purpose of transporting material from the storage yard to the front the contractor is provided with constant use of locomotive and ten flat cars. To facilitate the work of erection a regular programme for the loading of material was arrranged. Drawing 637-14 shows the method of loading a pair of 100-foot girders, with their accompanying floor-beams and stringers on two 80,000 lb. capacity 40-feet long flat cars, the girders being loaded at a height to suit convenient picking up by the erection traveller. The 67-ft. 1-inch girders, weighing about 30,000 lb. each, were loaded in a similar manner, as will be seen from drawing 637-15. The columns were loaded on flat cars with corbels of convenient height for lifting off by the erection traveller.

The main traveller for the erection of this viaduct is a very ponderous machine, built entirely of steel, except for some minor parts, such as the engine-house, and various platforms. (See illustration). It was designed with two principal trusses 207 feet in length, spaced 16 feet apart centre to centre, to suit the spacing of the main girders of the viaduct spans. The cantilever portion of the trusses have a reach of 116 feet, the balancing portion of the trusses being 91 feet in length. The rear end of each balancing truss is carried on a truck with three 24-inch cast-steel wheels, and the forward end is supported on four similar wheels. The rear end of the traveller is counterweighted with 46 tons of steel rails, in addition to the weight of the engine-house, platforms and hoisting machinery contained thereon. The traveller runs on 80-lb. rails on oak planking along the top flanges of the girders, the rails and oak planking being bolted together in sections, so as to facilitate its placing and removal with each movement of the traveller. The weight of the traveller in working condition is 712,000 lb. The clearance under the deck of the traveller was made sufficient to permit the running of flat cars loaded with girders under it. The strains of the traveller were carefully calculated for conditions shown on drawing A-76°, special attention being paid to the matter of wind stresses on account of the very high winds certain to occur during the time of erection, which was estimated to be one year.

A stress-sheet was made up on the expectation that it might be necessary to carry the entire weight of the bottom storey of the bent suspended from the end of the traveller, which would make a total load of 90,000 lb. at the end of the traveller. This estimation is due to the expectation of assembling such bottom storey flat on the ground and then lifting it vertically into position on the piers. This method was later abandoned in favor of placing each item in the bent directly in its final position. To carry out this latter plan it was found desirable to suspend from the end of the traveller the assembling cage indicated on plan 637-23.

The erection traveller is hung with four trolleys hung on two trucks 8 feet apart centre to centre, which trucks extend the whole length of the traveller arm and about two-thirds of the balancing arm. All of the material is taken directly from flat cars run under the rear end of the traveller and handled by these trolleys, each one of which is provided with a 40-ton hydraulic jack of 18-inch stroke, these jacks being used to lift the girders from the cars, as it was undesirable to set the traveller high enough to give head room for block and tackle for this purpose.

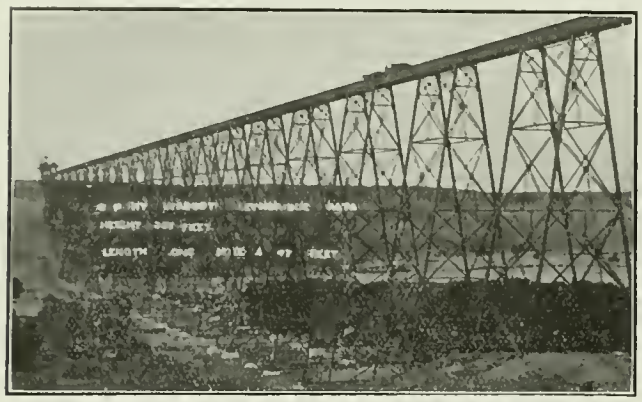
**Traveller Placing Girder.**

Girders were run out on flat cars under the traveller, and when transferred to these trolleys they were pulled forward on to the cantilever-arm of the traveller until in a proper position for lowering into place. Lighter material, such as longitudinal bracing, were lowered direct to the ground by wire-rope tackles, and were raised to position in the structure by special 85-ft. swinging booms of 5 tons capacity each, attached to the traveller.

In erecting the bents the traveller is moved to position to bring the hoisting tackle at the end of the traveller directly over the centre line of the bent to be erected, the overhang of the traveller being sufficient to span the maximum space of 100 feet made by the length of the intermediate girder span.

On completion of the lower storey of a bent supporting 100 ft. spans its top is braced back to previously-completed work by an erection strut, and similar struts are placed at each storey of the bent as it is erected, and when the bent is completed the 100-ft. span is put in place, the traveller moved forward, and the remainder of the tower completed, and the tower-span put in place.

All of the transverse connections and splices requiring to be field-bolted were rendered readily accessible to the



**Height, 307 feet; length, 1 mile and 40 feet.**

workmen by means of a cage suspended from the end of the traveller. On this erection traveller were placed six hoisting-engines, and a system of telephones was installed to establish communication between the men engaged in erecting material and those in charge of the hoisting-engines. The riveting of this bridge was carried on as quickly as possible after the material was put in place, and a separate traveller was used for this purpose, moving along the same track as the erection traveller.

The riveting traveller was built of timber, and high enough to permit of the passage of loaded flat cars beneath it. Riveting platforms were suspended on the sides from this traveller. All the riveting was done by pneumatic hammers. Compressed air of 100 lb. pressure was piped out on the bridge from the air-compressor plant placed on the ground near the Lethbridge abutment.

### General.

The raising of steel began about August 15, 1908, and a good deal of time was lost during the winter months on account of extremely cold weather, and two weeks in February on account of a strike of the workmen. During the month of March 1909, bents 37-46 inclusive were completely erected, comprising a tonnage handled during that month of 2,300 tons and about 735 lineal feet of structure.

A serious accident was averted because of the through-girder construction; a heavy derrick car handling some heavy material was accidentally tipped over, but was restrained from falling by the through girders.

The 167-feet span over the west bank was erected in the usual manner by falsework.

Quantities.—The quantities in the structure are approximately as follow:—Dry excavation, 18,110 cubic yards; wet excavation, 4,870 cubic yards; concrete, 17,090 cubic yards; concrete piling, 1,676 piles; riprap, 339 cubic yards; steel, 12,200 tons.

It required 645 cars to transport the steel actually used in the erection of the bridge to the bridge site. Contractor's plant amounted to about forty cars, tie and guard rail fifty-three cars, besides which there would be an additional number of cars for coal used on the work, which would make the total about 900 cars.

It is estimated that in order to give the bridge two coats of paint about 7,600 gallons will be required.

Records. — Throughout the work careful records were kept of all measurements, triangulations, and all other work, the note-books being carefully indexed. In addition to this, weather records were kept, together with notes as to the wind, as on many occasions the wind was so strong that men could not work on the erection of the bridge. In addition to this, records were kept showing progress of work in accordance with form, which is attached. These were sent into the head office twice a month in order that a check might be kept on the progress of the work. Attached are several photographs showing wooden trestles and bridges on the old line, and several photographs showing the pedestals, the river piers, and the steel-work of the new bridge.

High Water.—During high water a new channel was formed about 300 feet east of the old one, and considerable gravel was carried down and deposited in the vicinity of the bridge. This is shown on the counter map marked "C" attached.

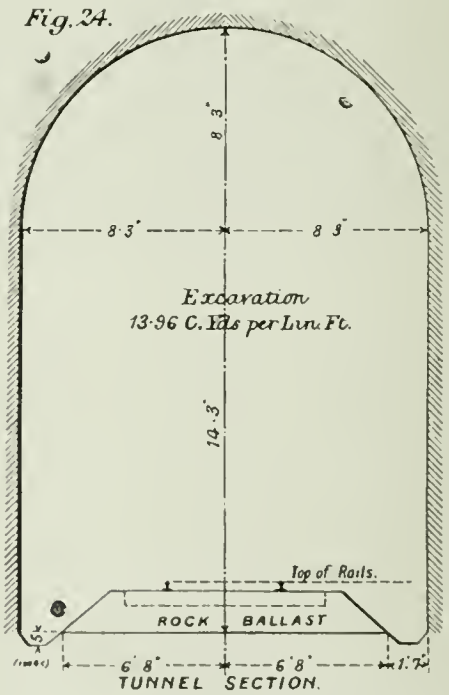
The bridge was designed by the bridge department of the Canadian Pacific Railway at Montreal, while the field work was carried out under the direction of the assistant chief engineer, Western Lines, Winnipeg.

The manufacture, designing of erection equipment, and erection of the steel-work were carried out in a most efficient manner by the Canadian Bridge Company, of Walkerville, Ont., contractors for superstructure. Mr. C. F. Prettie had direct charge of the bridge company in the field, and had a gang of about 100 men.

## Reduction of the Kicking-Horse Pass Grade Between Field and Hector on the Canadian Pacific Railway.

The original line of the Canadian Pacific Railway in the Canadian Rockies, between Field and Hector, was constructed for a distance of about 4.1 miles with 4.5 per cent. grade, which was the heaviest grade on the main line of the railway; this, however, answered all purposes until the increasing traffic during the past few years necessitated the consideration of a grade revision at this point, more especi-

*Fig. 24.*




TUNNEL SECTION.

ally owing to the large amount of passenger traffic and the danger of operating this 4.5 per cent. grade, although on this gradient there were three safety switches, one at mile 10.2, one at mile 11, and the other at mile 12.3. Before passing any of these switches going west on the down grade, all trains had to come to a stop, when a man threw the switch for the main line, allowing trains to proceed. Under an agreement with the Government, this gradient had to be reduced.

Special surveys were made in the years 1902 and 1905 of alternative routes. The different propositions finally resolved themselves into the consideration of three lines, as

shown in the plan, Fig. 21, page 327. The line which is marked "A" required the abandoning of Field and moving the terminal at this point, besides being very expensive work, running into a series of slides. From the appearance of the ground, the Yoho Valley, or the north branch of the Kicking Horse River, appears to lend itself readily to a location in this direction; but on account of the exceedingly steep banks, and a large number of snow and rock slides, this line was abandoned. It therefore necessitated the consideration of the lines shown in dot-and-dash line and dotted line on the plan (fig. 21). The dot-and-dash line required running parallel to the bed of the river at several points in order to secure the gradient; this would require the railway and the river to be carried through the same cuts, and on account of the danger of ice blocking the river, besides being a very expensive project to divert the river, this line was abandoned, and the dotted line adopted as a general location.

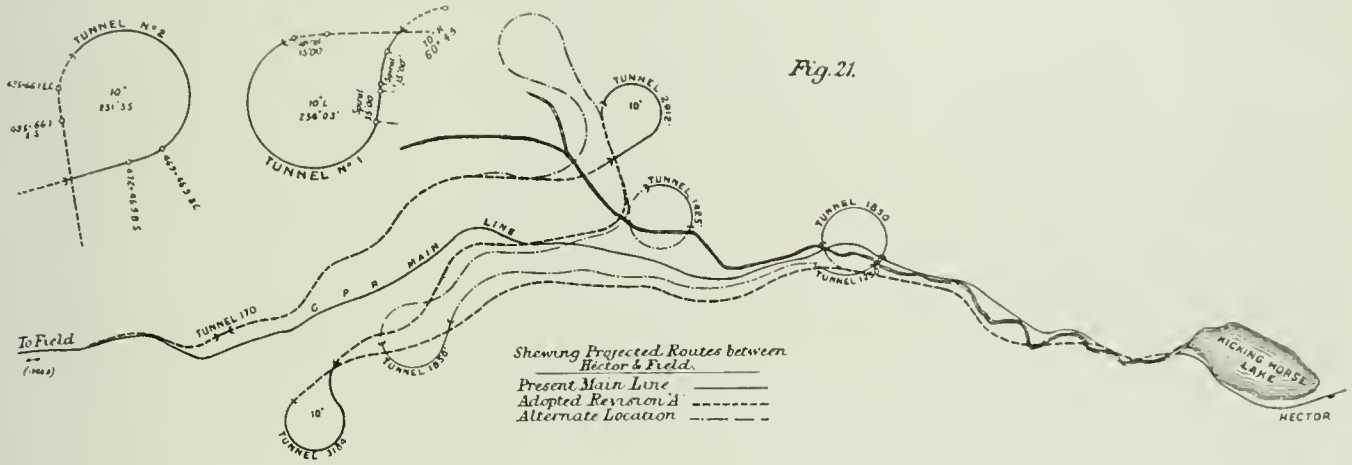



Fig. 21.

After having further surveys made, and in order to save length of tunnel, this was changed to the line shown in dot and dash; while this increased the curvature by 102 degrees and lengthened the line by 362 feet, the tunnel was shortened by 1,000 feet, and on account of the cost of the tunnel work it was decided to adopt this line.

Before actually starting the work on this line, further investigations were made up the Yoho Valley, and it was decided that it was impracticable to build a line up the valley, as, for a distance of two miles or more, it would be on the face of perpendicular rock-slides, ranging from 3,000 feet to 5,000 feet, besides which there would be several snow-slides to contend with, which would endanger the operation of the line. It was decided by the management to undertake this work in 1907, the contract being let to Messrs. McDonnel and Gzowski for the construction work.

There was no work of any particular interest outside of the ordinary grading except the tunnels. The tunnel known as No. 1 is 3,184 feet long, on a revrese curve shown on plan marked "A"; Tunnel No. 2, 2,912 feet long, being partly on a 10 degree curve radius 573.7 and partly on a tangent. Each of these curves have 300 feet of spiral at each end. The grade is 2.2 per cent., compensated at 0.04 per degree of curvature throughout, except in the tunnel, where 0.06 is used, and on the tangents in the tunnels an allowance of 0.02 was made for slippery rails.

As already stated, the maximum grade on the present line is 4½ per cent. for a distance of 3.71 miles, and the balance of 0.2 mile varies from 3.5 to 4 per cent. At the present time it requires four engines to handle a train of 700 tons over this grade, while it is estimated that with two engines of the same class the company will be able to haul 982 tons. The engines used in operating over this grade are what are known as 180 per cent. engines, having a total tractive force of 46,900 lb., the weight on the drivers being 173,700 lb., the total weight of the engine and tender loaded being 154 tons.

The amount saved on account of reducing this grade at the time the estimate was prepared was not in itself sufficient to warrant the expenditure; but, taking into account the question of handling passenger traffic so much more safely, as well as allowing longer trains to be operated, besides doing away with the terminal at Laggan, the terminal of the Western division being moved to Field, it was decided to go on with the work.

The work was started on this grade revision in September 1907, and it is estimated that it will be finished by August 15 of the present year.

The work on the tunnels was started from both ends, the contractor at first using an old-style Jumbo, but steam-shovels were later substituted in these tunnels, and the work progressed a little quicker. No great difficulty was experienced in the tunnel work, as it is through medium hard limestone, with a dip of about 20 degrees. A large quantity of timber was required in both the large tunnels on account of striking slides in the rock, and a little trouble was experienced from water, but this was kept under control at the upper ends with two small steam-pumps. The two headings in the tunnels met on May 22, the levels checking in Tunnel No. 1 within two-hundredths of a foot, and Tunnel No. 2 within one-hundredth of a foot.

The question of ventilation was investigated, but it was not considered that any would be required in either of these tunnels until the traffic increases to such a degree that it will be necessary to double track outside the present tunnels. On account of the tunnels being on a spiral, and the portals being in such close proximity to each other, there will practically be the same atmospheric conditions at the portals of each of the tunnels, and the tunnel should have a complete change of air in about 2½ minutes.

On account of the nature of the rock, which appears to slack after being exposed to the air for some little time, the greater part of the tunnels were taken out, so that they might be lined with concrete when that may be necessary. This will give a maximum grade of 2.2 per cent. through the mountains, of which there will be 12.7 miles east bound and 5.1 miles west bound.

As a comparison between other tunnels it might be stated that the present tunnels would have an area of 376.9

Fig. 22.

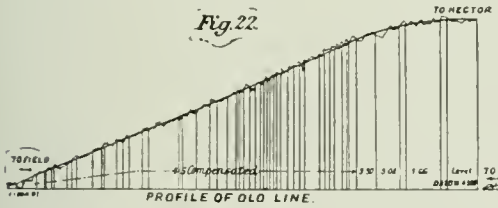
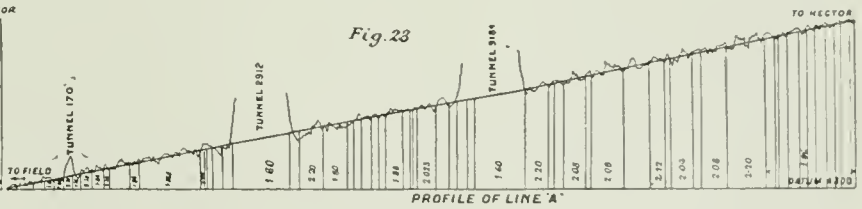



Fig. 23



square feet of section through the longest tunnel, the actual grade being 1.6 per cent.

The Elkhorn Tunnel, on the Norfolk and Western Railroad, is 3,000 feet long, with an area of 235 square feet, and a grade of 2 and 1.4 per cent. It was found necessary to install a ventilating plant in this tunnel, as the train movements were about 100 per 24 hours.

The Cascade Tunnel, on the Great Northern Railway.—Length, 13,280 feet; grade, 1.74 per cent. Up to the present there has been no ventilating plant used at this point, and it is proposed to operate this by electricity, the installation for which was to be completed about the end of June of the present year.

Stampede Tunnel, on the Northern Pacific Railroad.—9,844 feet long; area, 333.7 square feet; grade, 0.74 per cent. for 5,000 feet, then 0.2 per cent. to east portal. Completed 1888. No ventilation.

Boulder Tunnel, on the Montana Central Railway.—6,130 feet long; area, 230 square feet; grade, 0.6 per cent. ascending from east portal, thence 0.2 per cent. descending to west portal.

Busk Tunnel, on the Colorado Midland Railway.—9,400 feet long; area, 275 square feet; grade, 1.41 per cent. Built 1893. No ventilation.

Hoosac Tunnel, on Boston and Maine.—Double track, 4.7 miles long; area, 572 square feet; grade, 0.5 per cent. from each end to centre, at which point there is a shaft. This was operated without mechanical ventilation till 1899, though in the year 1890 it was considered to have reached its limit with 65 trains per day without mechanical ventilation.

Big Bend Tunnel, Chesapeake and Ohio Railroad.—6,500 feet long; area, 250 square feet; grade, ascending, 0.4 per cent. for 4,300 feet, thence, descending, 0.08 per cent. for balance. It was divided in three sections of about 2,000 feet by two shafts. These were found to be insufficient for proper ventilation when traffic reached 45 trains per day.

St. Clair Tunnel, Grand Trunk Railway.—Built 1901; 6,000 feet long; grades 2 per cent., descending, each way to centre of section of 2,000 feet, which is on 1 per cent. grade. Area, 300 square feet. No ventilating plant installed till at least 1904, when train movement became so heavy that it was necessary to install electric locomotives.

Arlberg Tunnel, on Arlberg Railway.—Completed 1883; 6.4 miles long; area, 442.6 square feet; double track; grade, 0.2 per cent. for 2.6 miles, ascending from east end, thence 1.5 per cent. descending to west end. Owing to increased traffic it began to give trouble in 1885, when the company began to use coke. In 1888 the traffic increased to 31 two-engine trains per 24 hours, but no abnormal effects were noticed till September 1890, when some workmen were overcome by gases, but recovered on removal to air. In 1894 started to use petroleum for fuel, and in 1896 all locomotives were equipped to burn petroleum which, has been satisfactory ever since.

St. Gothard Tunnel, St. Gothard Railway.—Nine and a half miles long; construction completed 1882; grade practically level, being only sufficient to provide drainage. The ventilation was natural till about 1899, when Saccardo system was installed. At this time the traffic was 61 trains per day.

The approach to the St. Gothard has seven spiral tunnels of the following lengths: 5,000 feet, 3,670 feet, 3,605 feet, 5,100 feet, 5,090 feet, 4,000 feet, and 5,010 feet, with grades of 2.5 per cent., with natural ventilation only; besides a straight tunnel of 5,150 feet.

Tangevand Tunnel, on Bergen and Christiania Railway.—Length about 5 miles; no ventilation; grade, about 1.5 per cent.

Khojak Tunnel, India.—Double track, three miles long. Was originally divided into three sections by two shafts, but on account of these shafts it was found that there was a dead section between the two shafts. These were then closed up, and till 1901 it was not found necessary to ventilate same.

## RAILWAY ORDERS.

(Continued from Page 320).

P.M.R.R. at P. C. west side of highway ¾ mile east of Glenwood Station, Ontario.

7901—August 31—Granting leave to the Princeton & Drumbo Telephone Company, to place its wires across the track of the G. T. Ry. at 6th Concession of Blenheim Township east of the middle townline, Ontario.

7902—August 31—Granting leave to the Bell Telephone Company to place its wires across the track of the C.P.Ry. between Wallace Avenue and Dundas Street, Toronto, Ont.

7903 to 7906, Inc.—August 31—Granting leave to the Alberta Government Telephones to place its wires across the track of the C.N.Ry. at four points in the Province of Alberta.

7907—August 31—Authorizing the Corporation of the City of Peterboro, Ontario, to construct sewer under the track of the G.T.Ry. Company, where it crosses Reid Street, Peterboro, Ontario.

7908—August 31—Authorizing the C.P.Ry. to construct industrial spur along the lane lying between Eigth Avenue and Dewdney Street and between Toronto Street and St. John Street, Regina, Sask.

7909 to 7913, Inc.—August 30—Authorizing the V.V. & E. Railway Company to construct five bridges at points on its line.

7914—August 30—Approving and sanctioning location of the C. N. Railway from mileage 0.00 to 51.50 in the Province of Saskatchewan.

7915—August 30—Approving location of the Superior & Western Ontario Railway Company's line between mileage 0 to 6.415.

7916—August 31—Sanctioning and approving location of the G.T.P. Railway Company's line from mile 100 to 150, British columbia.

7917—August 31—Authorizing the V.V. & E. Railway to construct bridge No. 409, at mileage 24.1 of its line.

7918—August 31—Authorizing the G.T.Ry. Company to reconstruct bridge to carry its tracks across the C.P.Ry. just west of Brockville, Ontario.

7919—August 27—Approving the location of the C.P.R. Company's station at Fort William, Ontario.

7920—September 1—Authorizing the C.P.R. to open for the carriage of traffic, the portion of the Mountain Section of its line between Hector, B.C., and Field, B.C.

7921—August 31—Authorizing the C.P.R. to construct overhead crossings at 6th Avenue at Moose Jaw, Sask.

7922—September 1—Approving detail plans of the C.P.R. also location of station at Upsala, Ontario.

7923 September 1—Approving location and detail plans of the C.P.R. station at Molson, Manitoba.

7924—September 1—Approving location and detail plans of the C.P.R. Company's station at Welwyn, Sask.

7925—September 1—Approving location and detail plans of the C.P.R. Company's station at Bulyea, Sask.

7926—September 1—Approving location and detail plans of the C.P.R. Company's station at Glenboro, Manitoba.

7927 to 7930, Inc.—September 1—Granting leave to the Bell Telephone Company to cross the tracks of the C.P.R. at four points in the Province of Ontario.

7931—September 1—Approving deviation of the location of portion of the C.P.R. from a point on the revision of the Crow's Nest Pass Branch to a point on the Calgary & Edmonton Railway in the Province of Alberta.

7932—August 31—Extending until October 15, 1909, the time within which the C.P.R. are required to complete the work on the Richmond Road viaduct, Ottawa, Ontario.

7933—August 30—Granting leave to the Superior & Western Ontario Railway, to open for the carriage of freight traffic, that portion of its line from the junction on the G.T.P.R. Company's Lake Superior Branch near mile 154, to the head of Sturgeon Lake, at O'Brien, a distance of seven miles.

7934—August 24—Granting leave to the G.T.P.R. to construct its railway across Norton Street, Edmonton, Alta.

7935—September 1—Authorizing the G.T.R. Company to construct six bridges on its Ottawa Division.

7936 to 7937—August 31—Authorizing the V.V. & E. Railway to construct bridges No. 437 and 400 on its line of railway over Twenty Mile Creek, and Similkameen River.

7938 to 7941, Inc.—September 1—Approving detail plan and location of the C.P.R. Company's stations at Redvers. Sask., Little Qualicum River, Graydon, Sask., and Goodlands, Manitoba.

7942—September 1—Authorizing the C.P.R. to construct spur to the premises of the Rocky Mountain Cement Company, Blairmore, Alberta.

7943—September 1—Extending until September 14th, the time within which the C.N.Q.R. may operate its trains for the carriage of traffic portion of its line connecting with the Quebec & Lake St. John Railway, in the City of Quebec to Garneau Junction, P.Q.

7944—September 2—Approving stress sheets of the G.T.R. for the Port Hope viaduct, Ontario.

7945—September 2—Approving strain sheets for bridge over Rideau River, at mileage 56.9, west from Hawkesbury on the Ottawa-Hawkesbury line of the C.N.O.R.

7946—September 1—Extending for a period of thirty days from 26th August 1909, time within which the C.P.R. may be permitted to commence the construction of subway at Iberville Street, Montreal, P.Q.

7947—September 2—Authorizing the N. St. C. & T.R. to constrnct spur from Fonthill station, Township of Thorold, Ontario, to Railton's Gravel Pit, Ontario.

7948—September 2—Authorizing the T.H. & B.R to construct spur to the premises of Messrs. Easterbrook & Bryan, Hamilton, Ontario.

7949 & 7950—September 1—Granting leave to the Dundnrn Rural Telephone Company to place its wires across the track of the C.N.R. at two points in the Province of Saskatchewan.

7951—September 2—Granting leave to the Alberta Government Telephones to cross the track of the C.P.R. between Sections 2 and 3, Township 11, Range 8, west of the 4th Meridian.

7952 to 7955, Inc.—September 2—Granting leave to the Bell Telephone Company to cross the tracks of the G.T.R. at three points in Toronto, and the C.P.R. at Westmount, Montreal, P.Q.

7956 to 7958, Inc.—September 2—Granting leave to the Manitoba Government Telephones to cross the tracks of the C.N.R. at two points and the C.P.R. at one point in the Province of Manitoba.

7959 & 7960—September 1—Granting leave to the Saskatchewan Government Telephones to cross the track of the C.N.R. and the C.P.R. at one point east in the Province of Saskatchewan.

7961—September 1—Granting leave to the Elmwood Rural Telephone Company to cross the track of the G.T.R. Company, at its Elmwood Yards, Elmwood, Ontario.

7962—September 1—Amending order No. 7698, dated August 3rd, 1909, authorizing the C.P.R. to construct spur into the premises of the Wood-McNabb Lumber Company, East Kootenay District; by striking out the figures "1465" and the word "Chains" where these words occur in the recital and operative parts of said Order, and substituting therefor the figures "1465" and the word "feet."

7963—September 1—Authorizing the C.N.R. to alter its existng level crossing on Pembina Street, Winnipeg, Man.

7964—August 31—Authorizng the C.N.R. to use Ticket and Baggage form in use on its lines west of Port Arthur, filed with the Board until the Board shall hereafter otherwise order and determine.

7965—September 2—Authorizing the Corporation of the City of Brantford, Ont., to construct sewer nnder the track of the G.T.R. on Gilkinson Street, Brantford, Ont.

7966—September 1— Recommending to the Governor-in-Council for sanction by-law of the C.N.R. entitled "A by-law respecting the travelling npon and use of the railway," and rescinding Order of the Board No. 7735, dated the 6th of August, 1909.

7967—September 2—Approving location of the C.N.R. Company's line of railway from a point five miles above Yale on the Fraser River to a point ten miles above Yale, in the Province of British Columbia.

## CITY OF WESTMOUNT DESTRUCTOR.

The City of Westmount have recently placed an order for a second refuse destructor which when installed will double the capacity of their present incineration plant.

The destructor will be of the Heenan patent type, consisting of three cells or furnaces arranged in one unit with a common combustion chamber. The complete unit will be of sufficient capacity to completely destroy by reducing to a clinker absolutely free from organic matter not less than 50 tons of refuse per twenty-four hours.

The destructor generally is in accordance with the British type which has proved so uniformly successful in many different parts of the world. The cells will be fed from the top. The charging will be considerably facilitated by a new and important improvement introdnced by the builders which enables each cell to be charged instantaneously. Instead of two men occupying five to ten minutes in shovelling in the refuse and at the same time a very considerable inrush of cold air taking place through the open charging door, the new Heenan system enables one man to handle the charging of the three cells. On the top of each cell will be a container holding snfficient refuse for one charge. When each container is filled, a door on the top is closed and a charging door at the bottom of the container is mechanically opened, and the charge drops down to the drying hearth inside of the destructor.

After remaining on the drying hearth for whatever time may be necessary, the charges are pnshed forward on to the grates through poking doors which are provided in the back of the destructor for this purpose.

The air for the combustion of the refuse is preheated in a regenerator through which the hot gases pass after leaving the boiler. The air travels the full length of the regenerator outside the tubes, the flue gases passing through the tubes. The heated air for combnstion is forced through the grate bars by a Heenan centrifugal fan operated by specially designed Heenan vertical, high speed, enclosed, self-lubricating engine.

Another important feature in connection with the installation will be the very efficient method of ventilating the incineration building, as the air supply to the forced draft fan is drawn by a duct from the upper portion of the building, inside thus effectively disposing of any dust and heat that may be present.

The heat generated in the combustion of the refuse will be utilized for the production of steam. The hot gases pass immediately from the combustion chamber of the destructor to a Babcock & Wilcox boiler in which a guaranteed evaporation of not less than 1¼ lbs. per lb. of refuse from and at 212 degrees will be obtained.

The new Westmount destructor will be similar to that installed by Heenan & Froude, for the Borough of Richmond, New York, the operation of which has been watched with the greatest interest by engineers in the United States, and concerning which data of considerable valuable have been published from time to time. The only other Heenan destructor in Canada is that at Vancouver.

The contract for this destuctor has been placed with Messrs. Heenan & Fronde of Manchester, through their Montreal agents, Messrs. Laurie & Lamb, Engineers.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

**MUNICIPAL ASSOCIATIONS**

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING — CONTRACTORS.—President, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION. — President, Thomas Southworth; Secretary-Treasurer, King Radiator Co., Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H Warder, Secretary.

## COMING MEETINGS.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received until Thursday, 23rd September, for the construction of a 2 feet x 3 feet brick sewer. John R. Barlow, city surveyor.

NOTRE DAME DE GRACE.—Tenders will be received until 20 September for construction of sewer. The Town Engineer, 335 Decarie Avenue, has plans.

QUEBEC.—Tenders for alterations to the Post Office Building will be received until Friday, September 24. Albert R. Decary, District Engineer, Quebec Post Office Building. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

QUEBEC.—Tenders will be received until Thursday, October 7, for the construction of a dam on Kipawa River, County of Pontiac. Plans may be seen at the offices of J. G. Sing, resident engineer, Toronto; J. L. Michaud, Merchants Bank Building, St. James Street, Montreal, and at the Department of Public Works, Ottawa. Napoleon Tessier, secretary.

THREE RIVERS.—Tenders will be received until Thursday, Sept. 16th, for supplying and installing pressure filters with a capacity of two million gallons per 24 hours. L. T. Desaulniers, Secretary-treasurer.

JOLIETTE.—Tenders for electric light wiring and fittings for the Armory will be received until Friday, September 24. A. Durand, Clerk of Works, Joliette. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**Ontario.**

PARKHILL.—Tenders for hot water heating system will be received until September 27. Plans may be seen on application to Mr. James Phelan, Clerk of Works, Parkhill, and at the Department of Public Works, Ottawa. Napoleon Tessier, secretary.

KINGSTON.—Tenders for heating apparatus, stable establishment, R.M.C., Kingston, will be received until Friday, September 24. H. P. Smith, architect, Kingston. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

GLENCOE.—Tenders for Post Office, Customs and Inland Revenue fittings will be received until Monday, September 27. J. E. Hull, Clerk of Works, Glencoe; T. A. Hastings, Clerk of Works, Toronto. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received until 28th September, 1909, for the construction of steel superstructures and floor systems for bridges at the points named below:

**District "A."**

| Mile | Bridge | Date of Completion |
|---|---|---|
| 82.0 | Cains River | December 1, 1909 |
| 124.5 | South-West Maramichi, N.B. | March 15, 1910 |
| 133.0 | South-West Maramichi, N.B. | March 15, 1910 |
| 134.07 | Juniper Brook | April 1, 1910 |
| 1.42.0 | Odell Brook | April 1, 1910 |

**District "D."**

| | | |
|---|---|---|
| 62.25 | Circle River | July 1, 1910 |
| 62.5 | Low Brush River | June 1, 1910 |
| 99.0 | Brule Creek | April 1, 1910 |
| 109.29 | Frederichouse River | April 1, 1910 |
| 113.48 | Buskegow River | April 15, 1910 |
| 123.5 | Driftwood River | May 1, 1910 |
| 135.0 | Mattagama River | June 1, 1910 |

Plans and profiles may be seen at the office of the Chief Engineer at Ottawa. P. E. Ryan, secretary.

FLESHERTON.—Tenders will be received up to September 20th for building a concrete bridge, 10 feet span, on the township boundary line between Glenelg and Artemesia. John A. Boyd, Reeve, Artemesia, Flesherton.

ORANGEVILLE.—Tenders will be received up to Tuesday, September 14th for supplying material, construction and erection of a steel highway bridge (75 feet span) over the Credit River. C. R. Wheelock, engineer, Peel County.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders are invited until 5th October by the City of Toronto for 16-inch cast iron pipe and valves. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in Canadian Engineer).

TORONTO.—Tenders will be received until Monday, September 20th, for the cut stone, brick and carpenter work in connection with the erection and reconstruction of the portions of the Ontario Parliament Buildings, recently destroyed by fire. F. Cochrane, Acting Minister of Public Works, Toronto.

TORONTO.—Tenders will be received until September 21st for construction of pavements, concrete sidewalks and sewers. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in Canadian Engineer).

**Manitoba.**

WINNIPEG.—Tenders for supply of cast iron water pipe of the following quantities and sizes, delivered f.o.b. cars, Winnipeg, namely, 20,000 feet of 8-in. pipe, 6,000 feet of 10-in. pipe, 6,000 feet of 18-in. pipe, will be received up to September 29. M. Peterson, Secretary Board of Control.

WINNIPEG.—Tenders will be received up to Monday, November 1, for supply of one motor hose wagon for the Fire Department capable of carrying 2,000 feet of 2½-in. cotton, rubber lined, fire hose, approximate weight, 2,200 lbs., and six men, approximate weight, 1,020 lbs. M. Peterson, Secretary Board of Control.

**Saskatchewan.**

YORKTON.—Tenders will be received until Tuesday, September 28th, for cast iron pipe and laying of mains. F. T. McArthur, B. Sc., Town Engineer. (Advertised in the Canadian Engineer).

**British Columbia.**

VICTORIA.—Tenders will be received until Monday, October 11th, for 2,500 feet of 12-inch pipe; 15,000 feet of 8-inch; 20,000 feet of 6-inch and must be delivered in 30-feet lengths, covered with jute and double coated, inside and out, with asphalt solution. Delivery must be made by March 15th next. W. W. Northcott, purchasing agent.

## CONTRACTS AWARDED.

**New Brunswick.**

MONCTON.—Tenders were received at the last council meeting for two 12-inch, two 8-inch, and eight 6-inch valves, as follows:—Canadian Fairbanks Company, $227.60; Sumner Company, $213.42; Coffin Valve Company, Boston, $232.20; Glenfield and Kennedy Company, Montreal, $241.90. The Sumner Company's tender was accepted. Tenders for two 4-K.W., and two 3-K.W. transformers were as follows:—Packard Electric Company, $173.18; Canadian General Electric Company, $191; Canadian Westinghouse, $208.72. That of Packard Electric Company was accepted. Tenders for 1½ dozen 5 amp. and ½ dozen 10 amp. electric meters were as follows:—Packard Company, $277.80; Canadian Westinghouse Company, $294; Ferranti, $253.36. The

Packard Company tender was accepted. The Sumner Company's tender, being the lowest for galvanized pipe, tees, valves and elbows, was accepted.

**Quebec.**

MONTREAL.—Gaudreau Freres have been given a contract for repairing the roof of St. Lawrence Market at $1,140.

**Ontario.**

COLLINGWOOD.—Wm. Simpson, of Collingwood, received the contract for sewer extensions at $6,700, the corporation to furnish two steam drills, two pumps and a steam boiler. Other tenders were Wm. McIllwraith, Collingwood, $7,200, town engineer, by day labor, $7,500 (including purchase of necessary plant.)

THOROLD.—This municipality recently invited tenders for the construction of 1,290 feet of 18-inch tile sewer and all appurtenances. The tenders follow:—

| | |
|---|---|
| *Peter Lorenzo, Niagara Falls | $3,277 |
| Daniel Oates, Thorold | 4,448 |
| David Walker, Thorold | 3,700 |

*Accepted.

TORONTO.—The Gutta Percha and Rubber Company, of Toronto, will be given a contract by the city for 7,000 feet of 2½-inch "Paragon" hose at 95 cents a foot.

TORONTO.—The following tenders were accepted for the erection of the new Parkdale Public School:—Masonry, H. Needham, $24,800; carpentry, Crocker & Le Drew, $13,500; plastering, T. Blackburn & Sons, $3,700; painting, J. Phinnemore, $1,525; plumbing, Fred. Armstrong Company, $1,880; roof and tinsmithing, A. B. Ormsby & Company, $1,807; heating and ventilating, J. R. Seager, $3,625; heat regulating, Johnston Temperature Regulating Company, $695. The total, $51,532, is well below the appropriation of $65,000.

**Manitoba.**

WINNIPEG.—The Canadian Westinghouse Company will probably receive the contract for supplying the city with 50 arc lamps and cut offs, for $1,637.50. Several other firms tendered, and their prices were identically the same.

WINNIPEG.—D. D. Wood will probably receive the contract for additions to the city hall annex. His tender is $17,500.

WINNIPEG.—The Brydges Engineering & Supply Company, Limited, have been awarded the contract for supplying a duplicate pumping plant to the Canadian Northern Railway, in two complete units, each one consisting of a gas engine, a Sutton gas producer plant and a Daniels high-speed pump. Each unit will be capable of pumping 500,000 gallons of water in twenty-four hours, and the plant will be installed in the pump house on the bank of the Red River, in place of the steam pumps at present in use. They will furnish water to the Canadian Northern shops and yards in Fort Rouge.

**British Columbia.**

NELSON.—The contract for the erection of the Y. M. C. A. building, was awarded to Thomas H. Waters and W. Pascoe. The cost will be $22,000.

VICTORIA.—The contract for 20 tons of pig lead will be given to the Robertson, Godson Company.

VICTORIA.—Tenders for 2-inch galvanized water pipe were received from the following: Colbert Plumbing & Heating Co., per 100 feet, $16.00; Hickman Tye Hardware Co., $18.91; Bonass Bownass & Co., $17.70; E. G. Prior & Co., $19.50; B. C. Hardware Co., $19.30; C. M. Cookson, $16; Walter Fraser & Co., $19.30; Andrew Sheret, $18.20. The tenders were referred to the purchasing agent.

VICTORIA.—Recently tenders were called by the city for the local improvement work on Cowan and Hulton Streets. The tenders for the Cowan Street work were as follows:—City Engineer, $2,422.80; F. Stedham, $2,765.20; A. Pike, $2,926.50. For Hulton Street the tenders were:—City Engineer, $4,725.60; F. Stedham, $5,208; A. Pike, $5,477. The city engineer was given the contract.

VICTORIA.—The city will purchase a new steam roller at a cost of $[illegible]362, from the Waterous Engine Works Company, of Brantford, Ontario.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—It is expected that the cars of the Montreal and Southern Counties Railway will be operating between Montreal and St. Lambert before the end of October. Save for about 400 feet of concrete wall, the tracks from the terminus in Montreal to Victoria Bridge have now been completed. The overhead work on the bridge has also been completed and the flooring and tracking is now being commenced. The work on the St. Lambert side, down to Longueuil, is being laid out, and tenders for the construction of this section will close on the 17th instant. The length of this section will be about four and one-half miles, and it is hoped to have the rails laid before the winter. The delivery of new cars will commence about the beginning of October. They will be of the vestibule type, with smoking compartment in rear, and with a capacity of sixty-five persons. The steam plant for the generation of the power used by the company is being installed by the Canadian Westinghouse Company.

MONTREAL.—At the last meeting of the Council of Longueuil, Mayor Geoffrion authorized the town engineer to establish the levels for the street tracks of the Southern Counties Railway, conjointly with the company's engineer. It is expected that the laying of the tracks will begin immediately and the work pushed ahead vigorously so that the cars may be running before the winter sets in.

VAL BARRETTE.—The C.P.R. have just completed a handsome No. 4 station at this point, which is on the Nominingue extension.

Mr. G. A. Mountain, C. E., Chief Engineer of the Dominion Railway Commission, accompanied by Mr. McCulloch, C. E., Division Engineer C.P.R., and Mr. Murphy of the traffic bureau, C.P.R., inspected the Nominingue extension on Friday, the 10th September. A service of trains began on Wednesday, the 15th September. The station at Mile 35, near the village of Rapidé L'Originale is completed and operations have been commenced on round house near by. The buildings on this extension were erected by Mr. C. E. Deakin, of Montreal; the engineer in charge of the entire extension was Mr. H. M. Dibblee, C. E., Nominingue, and the building inspector Mr. M. M. Campbell, C. E., of Ottawa. The track engineer was Mr. Wm. Patterson, C. E., of Carleton Place.

**Ontario**

PORT ARTHUR.—The City Council, Board of Trade, and Railway Commission are moving with the Townships of Oliver and Shuniah toward the organization of a company to construct twenty miles of rural tram lines to facilitate communication between the townships and the city. The city will likely assume sixty per cent. of the burden by guaranteeing its bonds while the townships will assist in a similar way to a smaller extent.

TORONTO.—It is understood that the C.N.R. will shortly invite tenders for the construction of the first 130 miles of the proposed Toronto-Ottawa line.

TORONTO.—The Grand Trunk Pacific have just placed an order for 22,000 tons of steel rails with the Algoma Steel Company. The Standard Inspection Bureau, of Toronto, have been retained as inspection engineers.

**Alberta.**

EDMONTON.—After an absence of seven months, William R. Clarke, financial manager af the Alberta and Great Waterways Railway Co., which holds a charter to build from Edmonton to Fort McMurray, and also holds a Provincial guarantee to bonds for the line, has returned to the city, and announces that he is prepared to commence immediate construction of the road. Mr. Clarke is accompanied by his entire staff of chief officials, including E. A. James, gen. man., who was formerly manager of the Canadian Northern Railway; Dr. Wadell, chief consulting engineer, and G. W. Minty, solicitor. Close upon fourteen millions of money was brought back from Europe by Mr. Clarke. Of this $7,400,000 is in stock, and $7,000,000 in bonds sold at a good figure.

The majority of the money is French capital, secured on the money market of Paris.

**British Columbia.**

NELSON.—A company with a capital of $50,000 has been formed in Nelson to operate a tramway system. The city council have practically agreed to guarantee a bond issue of $25,000; and a by-law will shortly be submitted to the ratepayers, judging from present indications.

VICTORIA.—The new line of the British Columbia Electric Railway from New Westminster to Eburne is rapidly nearing completion.

## FINANCING PUBLIC WORKS.

The following particulars refer to recent debenture issues:—

CHATHAM, N.B.—$25,000, to J. M. Robinson & Sons, St. John, N.B.

AMULREE, ONT.—$3,695.40, drainage, to G. A. Stimson & Company, Toronto.

TABER, ALTA.—$55,000, to W. A. Mackenzie & Co., Toronto.

NANTON, ALTA.—$5,000, to Nay & James., Regina.

MAGRATH, ALTA.—$14,000, to Nay & James, Regina.

WHITEWOOD, SASK.—$4,000, to Nay & James.

KILLARNEY, MAN.—$10,000, to Nay & James.

MELVILLE, SASK.—$6,000, to Nay & James.

NORTH EASTHOPE, ONT.—$3,695, to Geo. A. Stimson & Co., Toronto.

ALAMEDA, SASK.—$15,000, town hall debentures, to Hawkey, Somerville & Company,

STRATFORD, ONT.—$12,000, for water works, $18,000 for public schools and $17,000 for collegiate institute, to the Ontario Securities Co., Toronto.

WINDSOR, ONT.—$20,000, macadam pavement debentures, to Messrs. Aemilius Jarvis & Co., Toronto.

The following debentures were purchased by Messrs. Brent, Noxon & Co., of Toronto:—

VERMILION, ALTA.—$6,500.

DRESDEN, ONT.—$20,000.

CLINTON, ONT.—$26,000, waterworks.

THURLOW TOWNSHIP, ONT.—$6,500, school purposes.

TAY TOWNSHIP, ONT.—$4,500, schools.

INNISFIL TOWNSHIP, ONT.—$1,000, schools.

NEELON AND GARSON TOWNSHIPS, ONT.—$5,000, good roads.

STREETSVILLE, ONT.—$5,500 (guaranteed by County of Peel), for local improvements.

**Quebec.**

VERDUN.—This municipality has just completed its sale of 5 per cent. bonds amounting to $150,000. The purchasers were Messrs. St. Cyr, Gauthier and Frigon, at 106.06.

**Ontario.**

GODERICH.—The road machinery by-law of $10,000 was carried by the ratepayers on September 11th by a majority of 410..

TORONTO.—The City Council are considering the advisability of a by-law authorizing the expenditure of $500,000 on new buildings for the Exhibition.

**Manitoba.**

UNITY.—J. K. Hall, overseer, offers for sale $8,000 5½ per cent. 15-year fire and local improvement debentures.

**Saskatchewan.**

ARCOLA.—The waterworks debentures, amounting to $15,000, have been sold to Nay & James, of Regina.

**British Columbia.**

NELSON.—A company recently formed to operate a tramway system here have asked the city council to guarantee a bond issue of $25,000. A by-law will probably be submitted to the ratepayers at an early date.

VANCOUVER.—The ratepayers have passed the following money by-laws:—Waterworks extensions, $234,000; street improvements, $104,000; hospital, $30,000; incinerator, $20,000; jail and police court, $6,000; advertising, $4,000.

## LIGHT, HEAT, AND POWER.

**Quebec.**

VERDUN.—Mr. Charles Brandeis, consulting electrical engineer, of Montreal, has been retained by the municipality in connection with the proposed extensions to the electric light plant.

**Ontario.**

ST. CATHARINES.—The Welland Electric Co. expects to have its line to Thorold nearly completed in two weeks.

TORONTO.—The Board of Control have decided to lease to the Hydro-Electric Commission the site necessary for the local transformer station. The erection of the station will be begun at once.

TORONTO.—The work of constructing the Toronto transformer station in connection with the Hydro-electric power transmission line was commenced on Monday on Garrison common, near Strachan Avenue. All the stations along the line are now under way, and the commission is hastening the work as much as possible with a view to completion before the end of the year.

WELLAND,—Stamford Township Council refused permission for the Hydro-electric Power Commission to erect poles on the highways of the township.

**Saskatchewan.**

PRINCE ALBERT.—Mr. Charles H. Mitchell, of Toronto, who recently paid a visit to Lacolle Falls, thinks they are capable of developing 10,000 horsepower.

**British Columbia.**

FERNIE.—The new power house for the electric light plant is rapidly nearing completion and will be ready for the installation of the machinery in a few days. The special boilers have not yet arrived, however, and it will probably be a month or more before the system is in working order. The town has been without a lighting plant ever since the fire and the completion of the new system will be heartily welcomed.

LADYSMITH.—The pole line for the electric lighting of the city is now complete and work has been started on the power house.

## SEWERAGE AND WATERWORKS.

**Quebec.**

QUEBEC.—The Council have voted $2,500 to the Waterworks Committee for extensions in St. Malo Ward.

**Ontario.**

LONDON.—The city has signed a contract with the Hon. Adam Beck whereby an adequate supply of water will be obtained. The contractor will sink a number of artesian wells capable of a pumping capacity of 4,500,000 gallons, an economic supply of 2,000,000 gallons, and a visible supply of 3,000,000 gallons.

PORT ARTHUR.—John Galt, consulting engineer, Toronto, is here to advise the city regarding the placing of the intake pipe connected with the waterworks, which must be moved to allow the construction of the dry dock.

**British Columbia.**

FERNIE.—Good progress has been made on the construction of the new pipe line from Fairy creek from where the future water supply of the city is to be drawn. The excavating work has been completed from the Elk River to the Fairy creek falls, though the pipe has not yet been laid. The dam is under construction.

NELSON.—Sewer extensions, to cost $4,603, are being made by this municipality.

VICTORIA.—Mr. Ashcroft estimates the cost of bringing water from Sooke Lake and redistributing it to consumers as over two million dollars. The question will be considered at a special meeting of the council which will be held shortly.

## CEMENT—CONCRETE.

**Quebec.**

ST. LOUIS.—Much concrete work, in which sidewalks will figure largely, is contemplated by this municipality.

**Ontario.**

PETERBORO.—Messrs. George A. Begy & Company, of St. Catharines, have been awarded the contract for a large reinforced concrete bridge at Peterborough. They propose to start the work immediately.

TORONTO.—A new cement merger which welds into one company a number of important concerns not included in the big merger recently put through at Montreal, was consummated on the 7th September at a meeting of the various companies interested, held at the offices of Mr. J. R. Roaf, who will act as solicitor for the new organization. The company, which will be known as the Independent Portland Cement Company, Limited, will have a capital stock of $10,000,000, the head offices being at Toronto. Immediate application will be made for a charter, and as soon as it is obtained officers will be elected and operations commenced.

The companies which have already agreed to enter the merger, and their authorized capitalization, are as follows:—Brant Portland Cement Co., Limited, of Brantford, $500,000; Colonial Portland Cement Co., Limited, of Wiarton, $800,000; Hanover Portland Cement Co., Limited, of Hanover, $500,000; Imperial Cement Co., Limited, of Owen Sound, $300,000; Ontario Portland Cement Co., Limited, of Paris, $450,000; Bell's Lake Cement Co., Limited, of Markdale, $500,000; Superior Cement Co., Limited, of Orangeville, $500,000; Western Ontario Portland Cement Co., of Atwood, $500,000, and St, Mary's Portland Cement Co., Limited, of St. Mary's, $500,000. In addition to these companies, several other concerns are expected to join the merger.

As will be seen, all these companies are located in Western Ontario.

**Foreign.**

BOSTON, MASS.—The Hood Rubber Co. have placed the contract for their new building at West Watertown, Mass., with the Aberthaw Construction Co., of Boston. It is to be built of reinforced concrete, 96 x 80 feet, three stories high. Provision will be made for future additional stories.

For late construction news see page 314.

## MARKET CONDITIONS.

Montreal, September 15th, 1909.

According to all accounts, conditions throughout the United States continue to improve, not alone in the markets for pig-iron, but for steel and for the various products thereof. The price has shown a gradual advance for some time past, and is now firm at the top point, for prompt delivery, and also for next year's delivery. The active buying of railway material continues to be a feature of the situation. The production during the month of August has seldom been exceeded in the past, and any considerable increase during the coming few months would give a volume which would break all previous records. Under the circumstances, with good crops now assured, and with the purchase and production of iron reaching record proportions, and prices gradually advancing, the outlook not only for the iron and steel trade, but for general trade throughout the whole country, is all that was being looked forward to.

In Great Britain, the strongest feature would seem to be the optimism of the United States. There is also the fact that labor troubles, which all season were a bearish factor, have been removed, besides which there is unquestionably a better home demand and a slight picking up of demand from continental sources. Everything considered, the situation in England and Scotland is firm, and producers of pig-iron are able to add a little to prices, from time to time, without limiting the amount of buying but rather adding thereto.

Locally, the situation is unusually promising. The Dominion Iron and Steel, and the Lake Superior Corporation are running their plants at full speed, and the Nova Scotia Steel and Coal Company is in the same situation, having orders booked for a long time in advance. The Dominion Company is experiencing the best year of its history, the Superior Company is now able to make a large expenditure on the improvement to its plant, and the Nova Scotia Company, by virtue of its new financing, is in a strong position and will doubtless be able to begin dividends before the end of the present year. The result of all this is an added feeling of optimism in the future of the iron and steel trade of Canada.

During the past week, prices have continued steady. No changes of consequence have taken place either in pig-iron or in steel, or in any of the lines in which engineers are interested, so that last week's price list is practically repeated.

**Antimony.**—The market is steady at 8 to 8½c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.80 for 1 x ¼-base; tire steel, $1.90 for 1 x ¼-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¾-inch, $5.10; 5-16-inch, $3.95, ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 10c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 50 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¾-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of ⅝ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12 inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $1.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¼ to 6c.

* * * *

Toronto, September 16th, 1909.

Wholesale trade in metals and hardware shows a more active pace, the almost realized prospects of the former making "all hands" more or less buoyant. Builders' materials are in fair demand in Ontario, while in the city bricks and lumber are still moving freely. Cement is not active in Ontario, the market being greatly depressed. Glowing accounts of what the "merger" of plants is to accomplish in the way of economy and stimulus are beginning to appear in the daily papers; but up to date they have not helped the price which is extremely low and unsatisfactory. In camp supplies the only noteworthy feature is an advance of 10c. in sugars.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

"QUEEN'S HEAD"
CANADA
Galvanized Iron
The World's Standard for half a Century.
John Lysaght, Limited
Makers, Bristol
A. C. Leslie & Co., Ltd.
Montreal

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand increased within the last fortnight.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—The price continues low, $1.55 per bbl. in car lots, including bags. Demand is slack in Ontario, but some fair lots have been sold for Manitoba and Alberta. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra; in shop, $1.35. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not 60c.; No. 2 tarred, 62½c.; plain, 56c.
affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Salvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $2.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 38 inches wide; 10-gauge, $2.90; 12-14 gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15; 10¾, $4.50 per 100 lbs. Fleur de Lis—gauge, $4.50; 26-gauge, $4.25; per 10 lbs. This downward change is the result of dissolution of an agreement between British and U. S. makers. Impossible to say how long it will last.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Talk is still heard of an advance, but nothing definite.

**Lead.**—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—A fair demand is reported for city trade, not so much from the country. Southern pine is the main item here. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price 3n far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quntes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—An improved request is noted lately, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and we quote an advance of ½c., say 31½c. to 32c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Cheese.**—No old cheese on hand; new cheese, large, 13c.; twins, 13½c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 6 to 6½c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Scarce and higher. Tierces, 15½c.; tub, 15½c.; pails, 15¾c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Still advancing. Short cut, $27.50 per barrel; mess, $26.

**Potatoes.**—Ontario,.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¾ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, September 14th, 1909.

Business with wholesale houses of Winnipeg is good and becoming better every day, as it is now an assured fact that the West will have a large and abundant crop, and all lines of business are becoming visibly stronger. Country dealers are now ordering heavily, as in a very short time every available car will be in use moving the crop.

All kinds of building and roofing paper are in demand in country orders, and city trade in these lines is also very good with prices steady as quoted. The bar iron trade in Winnipeg and the West is more and more becoming a large faction in the hardware business; and the local bar iron factory have all the orders they can possibly handle, and are this year moving the factory to a more suitable site and doubling its capacity.

Coal is becoming active again, with prices remaining as usual. Cement is still quiet. Lumber also is not so active, the local carpenter's strike not yet being settled.

Winnipeg quotations are as follows:—

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy

Cement is again somewhat quiet and prices are pared down very low. A good demand is also noted for a better class of brick this season.

Winnipeg quotations are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in. $55; cull red or white pine or spruce $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft. $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain,

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $8

Approach to Huntley Street Bridge, Rosedale, Toronto, treated with "VULCAN FLUID ASPHALT" under direction of City Engineer, Roadway Department.

GOOD ROADS AT LITTLE COST.

# VULCAN FLUID ASPHALT

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A manufactured product carrying Asphalt in solution—entirely free from all the objectionab features of Crude Oil—sanitary and wholesome—a road builder—after one application roads remain dustless for a year or longer. We invite inspection of this product where it has been used on the streets of Toronto—**"the proof of the pudding is in the eating."** We guarantee it. Call and see us. Send for booklet

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"That obtained from The British American Oil Co., I think, is the preferable oil"—Dr. Sheard on Road Oil in "Canadian Engineer," July 16th, 1909.

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# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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Everything affecting the editorial department should be directed to the Editor.

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TORONTO, CANADA, SEPTEMBER 24, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## TECHNICAL SOCIETIES.

With the end of September comes the opening of the engineering societies throughout the country. Many engineers look upon the old evenings of fall and winter as delightful times for private reading and quiet evenings in the home. Others take an interest in technical societies and clubs and such institutions as may be used to improve their knowledge of the different branches of engineering and make them more efficient in their chosen calling.

Already we have heard on the street the perennial complaints: "Some members use our club to their own advantage too much."

"Why this waste of time?"

"Such general papers are of no value."

"Some papers last year were so highly technical in character that we could not listen to them."

That all money and time spent by and at these organizations is well spent we do not pretend to believe, but with all their faults these societies are strong factors in the professional life of the engineer.

We wonder sometimes if the "dissatisfied member" recognizes that those who get the most out of the society are the members who put most in. Because a man gets good because he does good, don't "grouch," but dig in and take your part. Do something to increase the standing and influence of the society. If you cannot read a paper, aid in discussion, interest someone who can. If you know of an engineer who has had good experience and is likely to be able to give an interesting paper, let the Executive know, and every chance you get boost, don't knock.

We do think, though, that the membership in general might be more largely interested in the work of each society if special committees were appointed, and under the direction of experienced chairmen they were led to investigate certain engineering problems.

Every city that has a branch of the Canadian Society of Civil Engineers or an Engineers' Club has also a university. The university in each instance has a capable staff and a laboratory. Both the university and the society would gain by demonstrations, tests and experiments made with the university plant and machinery.

The varying branches of Canadian industries require the engineer. Few engineers have the laboratory equipment that will enable them to investigate problems. The engineering societies and the universities should unite and assist.

Why not make a start in **your** society this autumn?

## CHEMISTRY AND ENGINEERING.

The recent report of a chemist on a water supply for a Canadian town has impressed the necessity of a closer alliance of chemistry and engineering, or, if you like, engineering and chemistry.

In the industrial plants throughout Canada the chemist has made many discoveries which were rapidly converted into successful manufacturing ideas, and for these the chemist must receive full credit. But as a rule the trained chemist is locked up in his laboratory and

shut out from the world of affairs, the equipping, the designing, the producing and the finishing end of the establishment. To direct the work of the chemist, to make full use of his discoveries, to secure full returns from his efforts, requires the knowledge and skill of the engineer.

The engineer is required to build, on commercial lines, the laboratory apparatus of the chemist. The chemist must guide and assist the engineer, and carry on cheaply in the laboratory experiments that would be ruinous if conducted in the factory or in the field by the engineer.

Happy the firm that can secure, in one person, the chemist and the engineer! This is seldom possible. Usually the combination is not profitable, but always the engineer and the chemist should understand each other and should co-operate.

## WATER CONSUMPTION.

The Water Commissioners for the city of Galt, Ont., have had considerable trouble locating the great water consumption or water waste that has been taking place. Recently, they put a meter in a local manufacturing establishment and found, in thirty-seven days, twenty-one hundred cubic feet, or for a year one million three hundred and twelve thousand five hundred gallons were used. For this, ten dollars was being paid.

Doubtless this was a great surprise to the Galt board, and there are surprises in store for any board of water commissioners that are able to install meters on an unmetered system.

Metering water supply systems is the fair way—fair to the taxpayer, the water user and the waterworks department, and the discovery of such conditions as were found at Galt will do much to educate those responsible for such installations.

## CEMENT MARKET IN NEWFOUNDLAND.

The increased cost of lumber and timber in the island has made the Newfoundland builder look to cement as a suitable building material, and greater quantities of cement are being used annually.

Last year Belgium imported into Newfoundland almost as much cement as did Canada. It is true the annual consumption of cement in the island is not large, the imports not exceeding 22,000 dollars, but the trade commissioners expect great growth in cement imports, and Canadian manufacturers should be able to enter the field and hold their own against Belgium and Great Britain.

## TIMBER CROPS.

In 1882, Cook Brothers, lumbermen, cut over the township of Sprague, a timber berth near the Serpent River in Ontario. This year the Saginaw Salt and Lumber Company have cut several million feet from the same limit, the Cook Brothers having thrown the limit up in 1882 as valueless. In twenty-seven years the saplings had grown to merchantable timber.

Another example is that of Cobden township, west of Blind River, Ontario. Some years ago an Ottawa firm cut over this limit. This year Moore & McDonald took off a second cut, and secured more than did the limit owner at the first cut.

The Ontario Government regulations now prohibit the cutting of trees less than ten inches in diameter and require that limit holders avoid injuring the growing crop, so that we may now expect to hear of regular crops of timber.

## STRESSES IN MASONRY DAMS*

**William Cain, M. Am. S.C.C.E.**

*Concluded from page 312, Vol. XVII.

On comparing these formulae with those of the writer, it will be observed that the absolute term in the value of q and a consequent term of the first degree in x, in the value of p', are lacking in Mr. Hill's formulae. This results from taking the inner face as vertical. Although the coefficients also differ, it is seen that the numerical values are very nearly the same.

In Fig. 6 are shown, on a drawing of the dam, to scale, the lines of the centers of pressure for reservoir full and empty.

To the right, and under the word "factors," are certain numbers, written in the form of fractions. For any joint, the upper number gives the factor against overturning, or the number by which it is necessary to multiply the water pressure down to the joint, to cause the total resultant to pass through the outer edge of the joint considered. The lower numbers give the ratio of the weight of masonry above a joint to the water pressure corresponding.

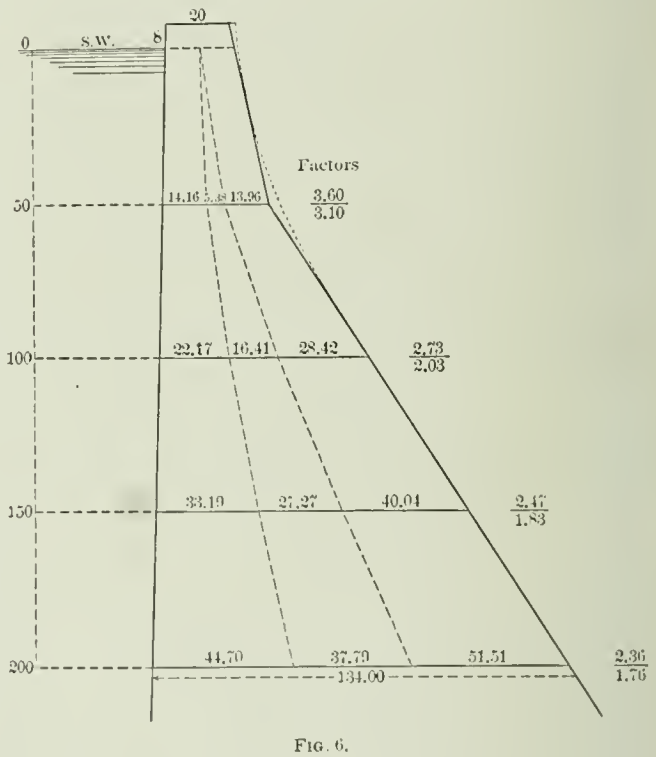



FIG. 6.

It is believed that these "factors" should increase from the base upward, to allow somewhat for earthquakes, expansion of ice in freezing, etc., since the effect of such accidental forces is proportionately greater on the upper joints.

Stresses due to water infiltration are not included here; neither are stresses due to temperature changes.

The unit stresses, f, in pounds per square inch, acting parallel to the adjacent face, are as follows, and refer to the outer edges of the joints, for reservoir full, and to the inner edges, for reservoir empty:—

| h, | f at outer edge, | at inner edge. |
|---|---|---|
| 50 | 85 | 58 |
| 100 | 136 | 133 |
| 150 | 204 | 180 |
| 200 | 275 | 228 |

The stresses, f, are normal pressures on planes perpendicular to the respective faces, and are the greatest stresses that can be experienced in the dam. In fact, they are greater than the true stresses, since the trapezoid law is not exact, particularly near the base, as before remarked. It would then seem that the dam, thus far, is safe, since the maximum unit stress is less than concrete, even, is subjected to daily, in good practice.

For an actual construction, the outer face should be curved, from near h = 50 to the top, as shown by the curved dotted line in Fig. 6.

The subject of the stresses in masonry dams has caused a great deal of discussion among British engineers in the last two or three years. The subject was reopened by Mr. L. W. Atcherly and Professor Karl Pearson,* who gave the results of certain experiments which seemed to indicate considerable tension across vertical planes near the outer toe. The late Sir Benjamin Baker, Hon. M. Am. Soc. C. E., also published† the results of experiments on a model dam of stiff jelly, and very recently, the "Experimental Investigations" of Sir J. W. Ottley and Mr. A. W. Brightmore‡ on elastic dams of "plasticine" (a kind of modeling clay) and the experiments of Messrs. J. S. Wilson and W. Gore§ on "Indian Rubber Models" have been presented.

It is not the object of this paper to discuss these later experiments; but it may be remarked that they show very plainly that no tension exists near the outer toe, but that tension does exist at the inner toe, where the dam is joined to the foundation, and it has become a serious matter how to deal with it. The influence of the foundation in modifying the distribution of the stresses at the base of the dam was found to be very great, causing the shear there to be more uniform than higher up, where the parabolic law, nearly as given by the formulae above, was found to hold. Also, above some undetermined plane, a small distance above the base, the usual "law of the trapezoid" was found to be approximately correct, leading to stresses on the safe side at the outer toe. This law leads to stresses at the outer toe of the base considerably in excess of the true ones.

It was found, from the rubber models particularly, as theory indicates, that the greatest normal pressures are exerted at the down-stream face, for reservoir full, and they act in a direction parallel to that face.

---

* Minutes of Proceedings, Inst. C. E., Vol. CLXII., p. 456.

† Ibid, Vol. CLXII., p. 123.

‡ Ibid, Vol. CLXII., p. 89.

§ Ibid, Vol. CLXII., p. 107.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

7986—September 1—Authorizing the Georgian Bay & Seaboard Railway Company to divert road allowance between concessions 9 and 10, Township of Tay, County of Simcoe, at mile 7.12.

7969—September 1—Ordering the C.P.R. to provide and construct at its expense highway crossings on the line dividing Range 1, N.E., Range 1, S.E., at mileage 2.9 and 3.5 from Megantic.

7970—September 2—Authorizing the Corporation of the Town of Orillia to lay sewer pipe under the track of the G.T.R. at Orillia, Ont.

7971—August 31—Authorizing the C.P.R. to construct branch line in the City of Winnpeg into the premises of McColl Brothers.

7972—August 31—Granting leave to the Pacific Coast Coal Mines, Limited, to cross by means of an undercrossing, the tracks of the Esquimalt & Nanaimo Railway Company in the Cranberry District, B.C.

7973—May 4—Approving plans submitted by Cameron & Co., Limited, of Ottawa, Ont., for siding to connect with the tracks of the G. T. Ry. near Aylen Lake Station, on its Ottawa Division.

7974—Sept. 2—Authorizing the Town of Arnprior to lay sewer pipe under the G. T. Ry. at Ida St. Arnprior, Ont.

9775—June 1—Granting leave to the Montreal Park & Island Ry. Co. to appeal to the Supreme Court of Canada upon the following question:—"Whether it is right or proper for the Board in making the said Order to overlook the contract bearing date the 7th day of November, A.D., 1907, and made between the said Montreal Park & Island Ry. Co. and the Municipality of Notre Dame de Grace.

7976—June 8—Granting permission to the Montreal Street Railway Co. to appeal to the Supreme Court of Canada upon the following question:—"Whether upon a true construction of sections 91 and 92 of the British North America Act and of section 8 of the Railway Act of Canada, the Montreal Street Railway Co. is subject in respect of its through traffic with the Montreal Park & Island Ry. Co. to the jurisdiction of the Board of Railway Commissioners of Canada.

7977—Sept. 3—Authorizing the C.P.R. to deviate portion of it line as constructed, between mileage 38 and mileage 39, West of Nelson, B.C.

7978—Sept. 3—Authorizing the C.P.R. to construct industrial spur through lots 37 to 43 inc. of Lot 5 in Parish Lot 47, St John, Winnipeg, Man.

7979 and 7980—Aug. 31—Authorizing the Corporation of the City of Toronto, Ont., to lay water pipe under the C.P.R. at Osler St. and Symington St., Toronto, Ont.

7981—Sept. 3—Authorizing the C.P.R. to construct and operate twelve industrial spurs, each crossing 7th Ave., at Regina, Sask.

7982—Sept. 3—Authorizing the Corporation of the City of Toronto, Ont., to construct a section of the High Level Intercepting Sewer between Tiverton and Carlaw Avenues across the land and under the track of the G.T.R., Toronto, Ont.

7983—Sept. 3—Approving plan submitted by the C.P.R. showing proposed double fifteen-foot one-beam girder of Bridge No. 55.5, Western Div. Sirdar Sec. of its line.

7984 and 7985—Sept. 7—Approving location of the C.N.R. Co.'s line up the North Thompson River, B.C.; mileage 46 to 55; and through Tps. 34-35, and Ranges 1-8; mileage 44.84 to mileage 93.85, Sask.

7986—Sept. 7—Authorizing the Drain Comm. for the Tp. of East Oxford, Ont., to construct drain pipe under the track of the Port Dover & Lk. Huron Ry. Co., near Woodstock, Ont.

7987—Sept. 3—Granting leave to the Coldstream Tel. Co. to place its wires across the track of the C.P.R. at Komoka, Ont.

7988—Sept. 1—Granting leave to the Yellow Grass Rural Tel. Co. to place its wires across the track of the C.P.R between Sections 13 and 14, Tp. 10, R. 17, West 2nd Mer.

7989—Sept. 7.—Granting leave to the Markham and Pickering Tel. Co. to place its wires across the track of the G.T.R. between lots 10 and 11, 5th Con., Tp. Markham, Ont.

7990 to 7998 inc.—Sept. 3—Granting leave to the B. T. Co. to place its wires across the tracks of the G.T.R., M.C.R. R. and C.N.R. at eight points in Ontario and one in Quebec.

7999—Sept. 7—Amending Order No. 5956 dated Dec. 22nd, 1908, directing the Que. Montreal & Southren Ry. to construct stations at Sorel, P.Q., & Pierreville, eight months from Dec. 22nd, 1908, by granting an extension of six months from Sept. 7th, within which to construct said station at Sorel, P.Q.

8000 to 8002 inc.—Sept. 3—Granting leave to the Man. Gov. Telephone Sys. to cross the tracks of the C.N.R. (1) and C.P.R. (2) at three points in the Prov. of Manitoba.

8003 and 8004—Sept. 1—Granting leave to the Alta. Gov. Tel. System to place its telephone wires across the track of the C.N.R. at two points in the Prov. of Alta.

8005 and 8006—Sept. 1—Granting leave to the Gov. of Sask. to cross the tracks of the C.N.R. with its 'phone wires at two points in the Prov. of Sask.

8007—Sept. 7—Exempting the British Yukon Ry. Co. from provisions of Order No. 7473, dated May 4th, as to the construction and maintenance of fences on either side of its right of way and of gates at farm crossings and of cattle guards.

8008 to 8010 inc.—Sept. 7—Granting leave to the Canadian Machine Tel. Co., Ltd., to place its wires across the track of the G.T.R. at Lindsay and Burford, Ont.

8011 to 8014, inc.—Sept. 7—Granting leave to the Corp. of the Village of Burlington, Ont., to lay water main under the tracks of the G.T.R. at four points at or near the Village of Burlington, Ont.

8015—Sept. 7—Approving deviation of Montreal Road by the C.N.R. in the Tp. of Cumberland, Co. of Russell, Ont., mileage 41 west from Hawkesbury, subject to the conditions that the road as diverted be put by the C.N.R. in as good order as the existing road.

8016—Sept. 8—Approving by-law of the G.T.P. Ry. appointing A. B. Smith, manager of the Telegraph Co., to prepare and issue tariffs of tolls to be charged for the transmission of telegraph messages over telegraph lines owned and operated by the company.

8017—Sept. 8—Approving and sanctioning location of the G.T.P. from east line of Sec. 1, Tp. 53, R. 23, to south line of Sec. 3, Tp. 52, R. 24, west 5th Mer. Dist. of No. Alta.

8018—Sept. 8—Granting leave to the B. T. Co. to place its wires across the track of the M.C.R.R. at P. C., ½ mile east of Welland, Ont.

8019—Sept. 8—Authorizing J. A. Coleman, of Winger, Ont., to lay gas pipe under the tracks of the G.T.R at P. C., two miles west of Marshville Stn., Ont.

8020—Aug. 26—Authorizing the Pembroke Lum. Co. to lay water pipe under the track of the C.P.R at or near the foot of Agnes St., Pembroke, Ont.

8021—Sept. 8—Authorizing the Corp. of the Town of Barrie, Ont., to lay sewer pipe under the tracks of the G.T.R. at Bayfield St.

8022 and 8023—Sept. 8—Granting leave to the Sask. Gov. Tel. to cross with its wires the track of the C.P.R. at two points in the Prov. of Sask.

8024 to 8026 inc.—Sept. 8—Granting leave to the Canadian Machine Tel. Co., Ltd., to place its wires across the track of the G.T.R. at three streets in the Town of Lindsay, Ont.

8027—Sept. 8—Authorizing the Orford Mt. Ry. to construct bridge No. 6 over Fyfield Brook, at Eastman, P.Q.

8028—Sept. 8—Authorizing the C.P.R. to construct bridge No. 125.2, Cascade Sec., over roadway near Vancouver, B.C.

8029—Sept. 8—Authorizing the Esquimalt & Nanaimo Ry. Co. to construct bridge No. 14.0 over Niagara Ravine, B.C.

8030—Sept. 8—Granting leave to the P.M.R.R. to move east derail and semaphore installed at Walkerville Jct., Ont., at Jct. with the C.P.R. to a point fifty-three feet further away from the crossing.

8031—Sept. 7—Granted leave to Robert Henry Edgar of Bowling Green, Ont., to place telephone wires under the tracks of the C.P.R. at Waldemar, Tp. of Amaranth, Lot 2, Con. 10, Ont.

8032—Sept. 9—Authorizing the Muncp. Corpn. of the Town of Gravenhurst, Ont., to lay water service main under the tracks of the G.T.R. at Brock and Muskoka streets, Gravenhurst, Ont.

8033 to 8035 inc.—Sept. 9—Granting leave to the Sask. Gov. Tel. Sys. to place its wires across the track of the C.P.R. at Crievale, Sask., and two other points in the Prov. of Sask.

8036 to 8041 inc.—Sept. 9—Granting leave to the B. T. Co. to cross the tracks of the C.P.R. and G.T.R. at various points in Ontario.

8042—Sept. 9—Granting leave to the Canadian Machine Tel. Co., Ltd., to erect its wires across the track of the G.T.R. at Burford, Ont.

8043—Sept. 9—Approving location of G.T.R. Co.'s station at Bluevale, Ont.

8044—Sept. 9—Granting leave to the Centre Thorah Tel. Assn. to cross the track of the G.T.R. with its wires in the Tp. of Thorah, Ont.

8045 and 8046—Sept. 9—Granting leave to the B. T. Co. to cross the track of the T. H. & B. Ry. near Grimsby, Ont.; and the M.C.R.R. at Bridgeburg Stn., Ont.

8047—Sept. 9—Authorizing the V. V & E. Ry. & Nav. Co. to construct bridge No. 439 over Similkameen River, between Keremeos and Princton.

8048—Sept. 9—Granting leave to the Corp. of the Village of Stirling, Ont., to erect electric power wires across the track of the G.T.R. at Old Marmora Rd., Stirling, Ont.

8049—Sept. 9—Approving of location of C.N.R. Co.'s line up the No. Thompson River from Nekaliston Creek to Coldwater River, B.C.

8050—Sept. 9—Approving location of the C.N.R. Co.'s line through Tps. 9-5, Ranges, 33-34, West Principal Meridian, and ranges 1-6, West 2nd Mer., mileage 16.09 to mileage 65.16, Prov. of Sask.

8051—Sept. 9—Authorizing the Q. Ry. L. & P. Co. to construct, maintain and operate proposed branch line of "Y" at St. Joachim, Co. of Montmorency, P.Q.

8052—Sept. 9—Authorizing the C.P.R. to lay its tracks across 18th St., Brandon, Man.

## INEFFICIENCY OF DAY LABOR IN MUNICIPAL WORK.

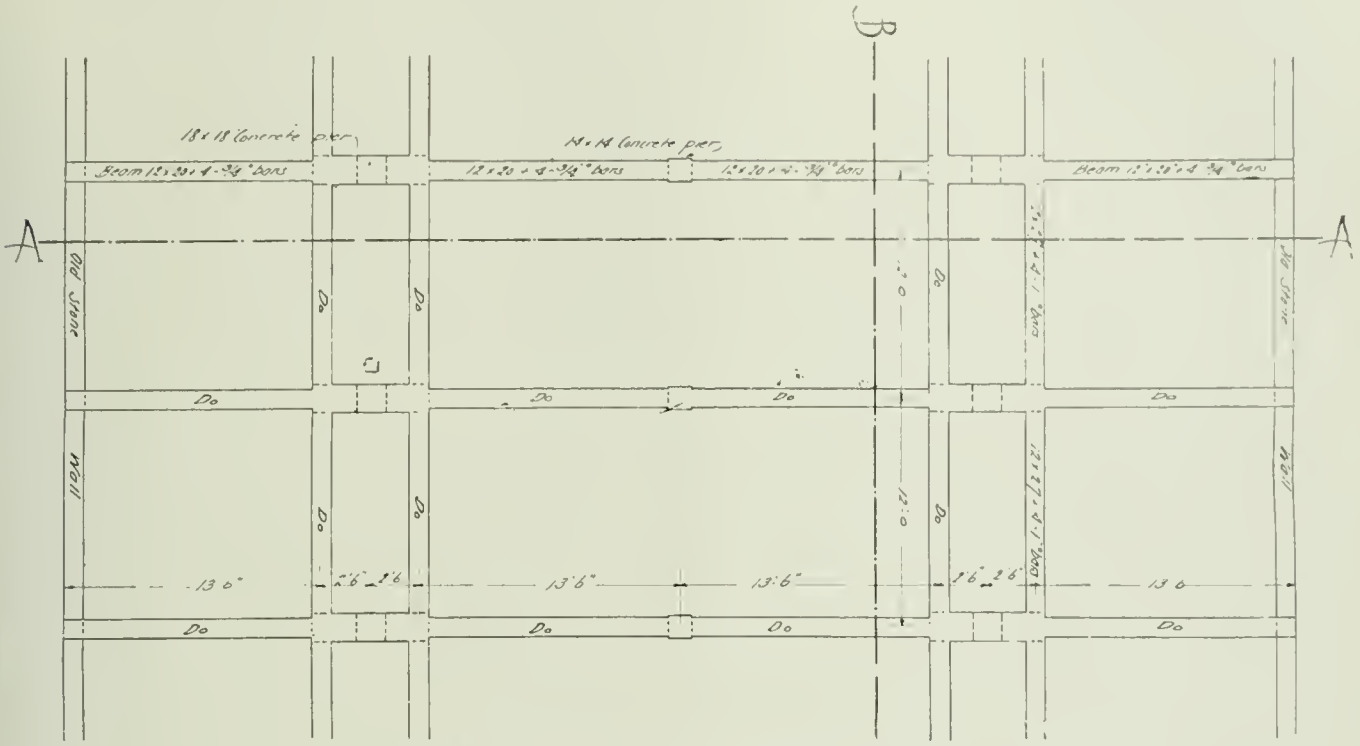
The recently published reports of Metcalf & Eddy, of Boston, consulting civil engineers to the original Boston Finance Commission, are exceptional in the thoroughness with which facts have been collected and marshalled to specifically show the inefficiency of day labor in municipal work. They found the Sewer Department to be reeking with abuses. To inefficiency and lack of discipline were added inadequate inspection and the pernicious effects of contracts given through favoritism at excessive prices. In fourteen years the annual expenditures on account of sewerage had increased 175 per cent., while valuation had increased only 44 per cent. and the population but little more than half as much.

Inefficiency was manifestly the goal toward which the Department was steadily keeping its course. Of about 775 men engaged upon day labor nearly 70 per cent. were over 50 years, and nearly 20 per cent. over 60 years. Not only were many of the force physically incapable of doing a fair day's work, but discipline was practically lacking—each man was a law unto himself, subservient only to the politician to whom he owed his position. But not content with insuring inefficiency and increasing the force through such means, the defined measure of a day's work was in many cases so established as to become absolutely ridiculous were the matter not so serious.

One time-keeper carried a book from the office to the job once or twice a day; a carriage painter worked an hour some days, and on many days never appeared at all; two men were stationed on a dump for more than a week after the wagons ceased to visit it; one man had nine lanterns to fill and clean each day, another twelve; some had only to hang up rubber boots to dry; a "syphon" man attended an hydraulic siphon which needed no attention; a "rubber goods repairer" who ordinarily had nothing to do sometimes assisted a clerk who had little to do; one storekeeper hardly ever appeared in the storeroom; a "stenographer" at $1,600 per annum seldom reported for any duty except that of political messenger; a "janitor" drew pay for seven weeks while he was sojourning in Europe. In ten districts, out of 579 men, 144 were employed as watchmen or in other positions, which required little effort, and 60 of these performed work of exceedingly slight value, or none at all. Inspectors were frequent offenders, and many of their written returns were practically useless. In some cases they were written wholly from imagination. The inspectors of catch-basins inspected usually from three to six basins a day, rarely over ten, although a fair day's work is fifty. Catch-basins which did not exist were included in the cleaning contracts at a fixed and excessive price; other basins were included in more than one contract, and paid for twice.

## A SIMPLE REINFORCED CONCRETE TRESTLE

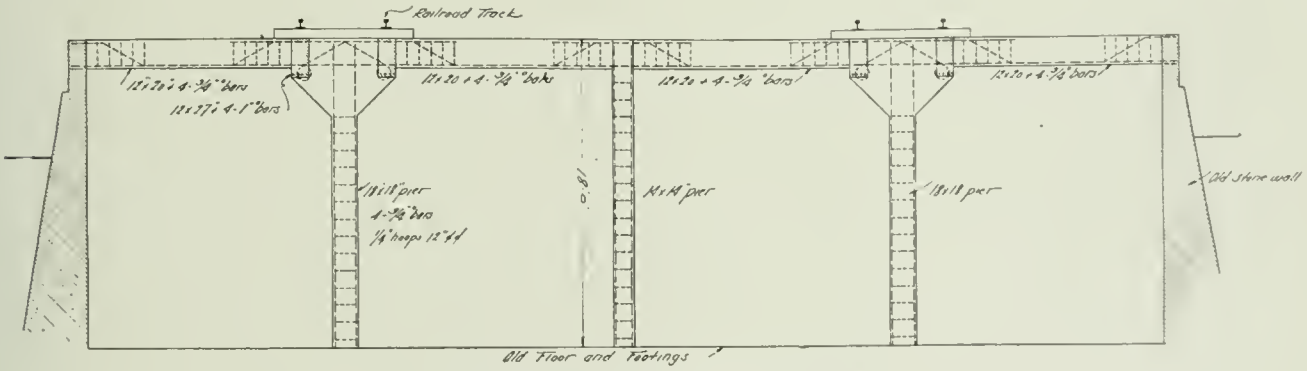
Among those manufacturing concerns aiming to reduce fire losses, maintenance charges, and insurance rates, by replacing their wooden structures with reinforced concrete, is the Jackson Manufacturing Co., Nashua, N.H. This company recently had built by the Aberthaw Construction Co., Boston, Mass., a reinforced concrete coal trestle capable of supporting the heaviest coal cars. It covers the entire length of their coal pocket and is limited in width by the stone retaining walls of the pocket. The illustrations shown herewith give a very good idea of the design.



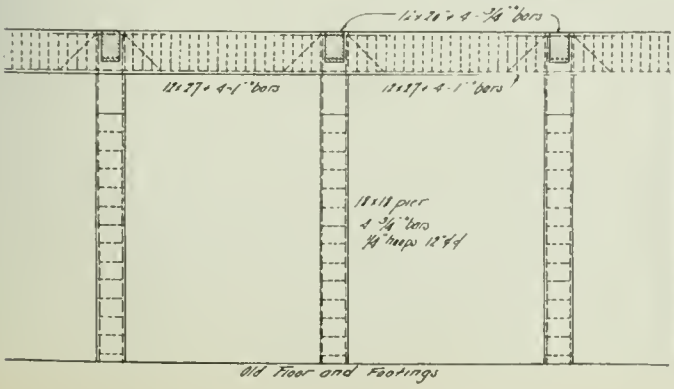

**Design of Reinforced Concrete Coal Trestle.**

The new trestle is designed for two parallel tracks 32 feet apart at a level slightly higher than 18 feet above the bottom of the pocket. The stone retaining walls 64 feet apart, furnish support for the ends of the cross beams. With this exception the entire structure is of reinforced concrete.

Further support than that given by the retaining walls is furnished by three rows of longitudinal columns, one row in the middle and two on each side, the two latter having spread tops for the purpose of adequately supporting the two parallel beams of 12 by 27 inch section, under each track. The middle row of supporting piers are 14 by 14 inch section while those on either side are 18 by 18 inch. The latter are reinforced by four ¾-inch steel bars in the corners, stiffened by ¼-inch hoops, 12 inches on centres. The 14 by 14 inch piers are similarly reinforced.


Railroad Track
12 x 20 x 4-¾" bars
12 x 27 x 4-1" bars
12 x 20 x 4-¾" bars
12 x 20 x 4-¾" bars
12 x 20 x 4-¾" bars
18 x 18 pier
4-¾" bars
¼" hoops 12" ct
14 x 14 pier
18 x 18 pier
Old stone wall
8'0"
Old Floor and Footings

**Reinforced Columns Supporting Trestle.**




The transverse beams, 12 feet centres, which rest on their ends on the stone side walls, intersect the heavier longitudinal beams directly over the columns or supporting piers. The 12 by 27 inch beams have steel reinforcement consisting of four 1-inch bars in each beam near the bottom. These are turned up near the supports to take care of the shearing stresses. Steel stirrups are extensively used as an aid in the reinforcement. The tie beams are reinforced by four ¾-inch bars in a manner similar to those under the tracks except that the use of stirrups is discontinued along the middle portion. All beams are reinforced near the top surfaces over all piers to take care of the tensile stresses at these points. The old floor and footings were used as a foundation for the supporting piers. The entire construction is heavily built with the view of accommodating the largest coal cars.

## CHARACTERISTICS OF THE ARTIST-ENGINEER.

By Victor C. Alderson.*

The characteristics of an artist-engineer may be divided into four main groups—physical, personal, intellectual, and moral. An engineer is called upon to do hard work. His physical frame should be capable of enduring long, continuous strain. Especially should his heart be sound, for work in high altitudes is severe upon the action of the heart. A man with a weak heart should not regard mining engineering as his calling. His physique would not endure the strain. While not absolutely necessary, yet it is exceedingly desirable, that his stomach should be able to digest heavy bread, soggy potatoes, and tough meat, for such are too frequnetly found in mining camps.

The more successful a mining engineer becomes the more necessary is it for him to be above reproach in manners, speech, and dress. If he does not rise above the work of mine surveying, assaying, or bossing a gang of foreigners, then he need not worry himself about his manners. But if he rises in his profession, if he becomes manager, superintendent, expert, or artist-engineer, then he necessarily comes in touch with the more influential men of affairs. Then his manners, his speech, and his dress must be that of his associates. It may be hard to change at once from the miner' boots to the button shoe, from the forcible but inelegant language used underground to the language of gentlemen's clubs, from the rough and ready greeting on the mountain to the more polished form of the drawing-room. Yet the artist-engineer must be prepared to make the transformation. The higher his professional standing the more he comes in touch with men representing financial interests. He cannot afford to be a curiosity blown down from the mountains. His habits, his manners, his speech will all count for or against him. It is well for a young engineer to bear this in mind, for while these personal characteristics do not make a man, yet they help mightily.

It is almost superfluous to say that a sound technical training is a requisite for an engineer, yet I mention it only as an introduction. Do not think that your education has more than begun. To be sure you shall shortly receive your college degree, but immediately after that you must enroll in a new school of learning—the University of Hard Knocks. In this university you will be judged with strict severity and not always with justice. No "cuts" are allowed; no credit is given for being pretty near right; no excuses are taken when you are just a little late; the manager seems utterly cruel if by chance you oversleep and are late at your work. In this University of Hard Knocks vacations are few and short; "spring fever" is a disease not allowed on the premises; only absolute promptness, accuracy, and successful accomplishment are accepted.

During your professional life you should form early certain habits that will do much to mould your intellect in the right way; that is, you should read, think and write.

Read. For your reading you should eliminate as far as possible the "flotsam and jetsam" of the daily paper; that is, the sensational features. Select the real news of the working world, discard the rest. Do not, under any circumstances, depend upon the daily press for your intellectual stimulant. Select one or two of the better technical papers, read them carefully, digest them thoroughly, and make their contents absolutely your own. In this way you will be able to keep in touch with the best professional thought and practice.

After reading, think. Do not be deluded by the thought that one reading is enough. After reading an important article, make a synopsis with headings and subheadings. See if the writer has made a logical presentation of his topic. Ask yourself how you could improve it. Try to recall other articles on the same subject. If the article is argumentative, weigh carefully the arguments presented, think out some of your own, and then draw a conclusion. In other words, study your technical papers carefully. There is no professor in this University of Hard Knocks to bother you with examination questions; you will not be "passed" in any subject; but when the opportunity for advancement comes, "the powers that be" will decide whether or not "you are fit for more than the thing you are now doing."

Write. Do not fail to begin early a simple yet systematic form of note-taking. The artisan never takes notes; the artist always does. There are few things that keep a man's intellectual life so active as the plan of systematic note-taking. Try it—it may make an artist-engineer of you. After you have advanced sufficiently to have something to contribute to the literature of your profession, write what you have and send it to some technical paper. If it is worth printing, the editor will accept it. If it is worthless, as may be the case, do not be discouraged; read more, think more, observe more, and try again. Editors are not heartless; but they do have an unerring sense of the difference between an article of real merit and trash.

Strange as it may seem to you, young men, I believe it is literally true that three-fourths of an engineer's success depends upon his character and only one-fourth upon his ability and education. Yet why do we have no professors of character in our colleges? A smart but unprincipled man is to be shunned. The man of good character and good standing is always held in high esteem. Character has real commercial value. If any of you ever seek a position where you are to be put under bond you will find that your bonding company will look into your habits with coldblooded scrutiny. They will ask about you such pointed questions as these:—

Does he gamble?

Does he play the races?

Has he ever been intoxicated?

Has he ever been guilty of any dishonorable act?

These questions are not asked from any morbid curiosity, but simply to determine from a purely business point of view whether you are a good moral risk—one which the bonding company can assume. The man who cannot satisfy these demands remains an artisan-engineer; the one who can may, perhaps, become the artist.

It is a mistaken notion that men of low character, who drink, gamble and act dishonorably hold positions of high trust and responsibility. They do not, or not for long, because as a pure business principle it is too dangerous or too costly to keep them there. Only two classes of men seem to come outside this category—the multi-millionaire, who has more money than he can spend, and the hobo, who has nothing.

Don't be in a hurry to choose a specialty. You may need experience and a wide variety of work in order to succeed as a specialist. At first when you are laying a foundation for future success be content with a living salary. Pronounced success will bring its own financial reward. Avoid small, petty, professional jealousies. They injure you more than they do the man of whom you are jealous. Seek to learn from every one—even the humblest worker. Remember that in all things high and fine you get only as you give. Give of your knowledge and talents in order that you may receive. Secret processes are going out of fashion. In scientific and technical matters you can gain more by being frank and open than by being secretive. You will receive only as you give.

Above all be willing to pay the price of success. Too many young men are not so willing. They hope to spend half the night in boisterous living, exhaust their energies in sensuous pleasure, and then be promoted to higher pay and greater responsibility. To succeed you must pay the price; that price is hard, diligent work, supported by absolute faithfulness to your employer's interest. Make your employer's interests your own. If you are fit for better things, for promotion, for advancement, it will be to your employers' advantage to call on you. If you pay the price for success, success will be yours.

* President Colorado School of Mines. Abstract of an address delivered before South Dakota School of Mines.

It is unfortunate that the engineering profession in general and mining engineering in particular has no such well-established code of ethics as prevails in law or medicine. While the advice, "caveat emptor" (let the purchaser beware) is always sound, yet we can hold only in contempt the promoter who capitalizes a barren hole in the ground, and mines, not in the ground, but in the pockets of his dupes. Such men should be placed in a class of Separators, because all they do is to separate people from their money. While there is no crystallized code for you to follow, yet you can make one for yourself.

Let me urge upon you to keep in mind always the ideals which will make of you artist-engineers. Few men have put this thought in a more striking way than William Ellery Channing. Remember it:—

"To live content with small means; to seek elegance rather than luxury, and refinement rather than fashion; to bear all cheerfully, do all bravely; to listen to the stars and birds, to babes and sages with open heart; to study hard, think quietly, act frankly, talk gently, await occasions, hurry never; in a word, to let the Spiritual, unbidden and unconscious grow up through the common; this is to be My Symphony."

## UNION OF SASKATCHEWAN MUNICIPALITIES.

The fourth annual convention of the Union of Saskatchewan Municipalities was opened on Tuesday, September 14th, by His Honor Lieutenant-Governor Forget in the presence of a representative number of delegates, who were welcomed by the Lieutenant-Governor and the mayor of Regina. Following addresses by the president and Hon. J. A. Calder, who spoke on "Municipal Government," two illustrated lectures—one on "Water Supply and Purification," by Mr. T. Aird Murray, C.E., of Toronto, consulting sanitary engineer to the Saskatchewan Government; and the other by Dr. R. M. Seymour, Provincial Medical Health Officer, on "Milk in its Relation to Public Health," were listened to with considerable interest.

# LATE CONSTRUCTION NEWS.

## CURRENT NEWS.

**New Brunswick.**

ST. JOHN.—English prospectors have struck natural gas at a depth of one thousand feet in Albert county.

**Ontario.**

OTTAWA.—The city council almost unanimously passed a by-law sanctioning the purchase of a site for a civic incinerator plant at a cost of $10,000.

OTTAWA.—Dr. Eugene Haanel, Director of Mines, recently stated that arrangements are being made for establishing the first electric smelting plant in Canada in connection with the Sault Ste. Marie iron and steel industries. The Lake Superior Company is arranging for the construction of a number of furnaces similar to those now in successful operation in Sweden.

PORT ARTHUR.—Competitive preliminary plans for a library building, to cost $25,000, are invited by J. Wink, librarian.

TORONTO.—City Engineer Rust recently estimated the cost of a viaduct from the present terminus of Bloor Street, at Sherbourne Street, to Danforth Avenue, in connection with the proposed extension of Bloor Street, at $619,000. This did not include land damages.

TORONTO.—Tenders for the burned over sections of Mississauga forest reserve have been accepted by the provincial government. The successful tenderers are James Munro, Pembroke; Booth and Shannon, of Biscotasing, who get two berths; W. B. Russell, Toronto; Richard Frier and J. G. Forgie, Pembroke. The average price is the highest yet obtained for timber berths rights. The best price tendered for white pine on the berths is $11.37 per thousand feet board measurement and the lowest $10.55, while for red pine, jack pine and spruce the highest price is $8.55 and the lowest $3. This is in addition, of course, to the usual stumpage and rental dues.

**Manitoba.**

WINNIPEG. Messrs. Pratt & Ross, structural and civil engineers, of Winnipeg, new advertisers in this issue, report having had a splendid season's work. They were the designers of the larger Horse Show Pavilion in Winnipeg; have prepared the plans for the new C.N.R. station at Brandon, and also for the alterations in the splendid new Grange Hotel, Winnipeg. Mr. Pratt designed the Fort Rouge C.N.R. shops this season also, and Mr. Ross is manager of the construction of the Union terminus at Winnipeg for the C.N.R. and the G.T.P. The firm are consulting hydraulic engineers for the Winnipeg Electric Railway, and have also a very difficult piece of work on their hands just now in the reconstruction of the sewer and waterworks system at Carman, Man.

The Brydges Engineering and Supply Co., of Winnipeg, are supplying two of their Daniels gas engines and gas producer plants, along with two pumps, for use in the C.N.R. shops. The pumps will have a capacity of 500,000 gallons per day, each unit, and the plant is to be ready by the end of November.

A total of 6,060 new applications have been made to the Provincial Telephone Commissioners since January 1st. Of these, 5,790 have been accepted, of which 3,240 are in the rural districts, while the remaining 2,550 are in towns. The Commissioners think it necessary to construct 4,000 miles of new lines this year.

**British Columbia.**

PRINCE RUPERT.—A shot, in which were used 25¼ tons of virite and 800 pounds of dynamite was fired here last week. It is estimated that 45,000 yards of rock were broken up, and most of it into small pieces.

VANCOUVER.—Machine and locomotive works to cost $300,000 will be running in Vancouver within six months, according to the plans of the Sumner Iron Works Co., of Everett, Wash., whose officials recently closed a deal with John Hendry, whereby they acquired, for $25,000, 30 acres of land in Burnaby.

## MISCELLANEOUS.

**Nova Scotia.**

GLACE BAY.—The reconstruction of the Marconi station at this point will be commenced at an early date. Mr. Marconi has just arrived from Europe to superintend the work.

**Ontario.**

ELK CITY.—Twelve miles of the new wagon road from Elk Lake to Gowganda have been graded. Work is being done from the Elk Lake end, and the entire twenty-seven miles are to be completed by December 1st.

KINGSTON.—The matter of dredging and re-opening the Wolfe Island canal is being discussed in civic circles here. The canal, which was formerly six feet deep and now only three, was closed in 1890.

OTTAWA.—Three hundred thousand dollars will be spent on the improvement of roads in Carleton County, which comprise 210 miles of the chief highways. A permanent engineer will be engaged and $15,000 will be spent in equipment, including steam roller, steam shovels, graders, stone crushers, etc. All the roads will be levelled, well drained and graded where necessary. Warden Dow, Mr. W. R. Cummings and Mr. W. J. Armitage have been untiring in advancing the scheme. The provincial government refunds to the county one-third of the cost of the road, the salary of the engineer and the cost of the equipment.

SAULT STE. MARIE.—The directors of the Lake Superior Corporation state that the plant will be enlarged.

**Manitoba.**

WINNIPEG.—The Canadian Westinghouse Company have purchased a site in Winnipeg on which they will erect

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Sept. 14 1909 | EARNINGS Week of Sept. 14 1908 | STOCK QUOTATIONS TORONTO Price Sept. 17 '08 | Price Sept. 9 '09 | Price Sept. 16 '09 | Sales Week End'd Sep. 16 | MONTREAL Price Sept. 17 '08 | Price Sept. 9 '09 | Price Sept. 16 '09 | Sale Week End'd Sep. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $1,836 000 | 1,431.000 | ..... | 180½ | 180⅝ | 182½ 181¾ | 375 | 170¼ | 170½ | 181 180 | 182¼ 182 | 940 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 239 700 | 202,800 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 897.498 | 806.696 | ..... | ... | *1st. pref. 107½, 3rd pref. 58⅜, ordinary 24¾ | | | ..... | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | 34,388 | 18,554 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138 3 | 18,000 | 100 | 76,361 | 74,730 | ..... | ..... | ..... | ..... | ..... | 179 | 178 | 225½ 214 | 214 213½ | 169 |
| Toronto Street Railway | 114 | 8,000 | 100 | 114.488 | 106,946 | ..... | 126 | 125½ | 124½ | 250 | 103½ | 103 | 125½ 125 | 124½ 124¼ | 512 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 167½ | | 187 | 170 | 40 | 170 | 165 | 187 | 187 | ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

a large building this fall, which is to be eventually seven storeys high but probably only four storeys will be finished by December 1st, when it will be occupied. James McDiarmid will build it and J. H. G. Russell is the architect.

WINNIPEG.—The Western Iron Works, who make a specialty of ornamental Iron work have had a busy season and are working up to their full capacity to keep up with orders in hand. They have practically all the contracts for ornamental Iron on most of the large buildings in Winnipeg as well as many throughout the West.

## PERSONAL.

MR. J. K. ROBERTSON, M.A., of Perth, has been appointed lecturer in physics in Queen's School of Mining, Kingston. He is an honor graduate of Toronto University.

MESSRS. PEACOCK BROS., engineers, and representatives in Canada for well-known British engineering firms, have moved their offices from the Canada Life Building to 68 Beaver Hall Hill, Montreal.

MR. GEORGE CUNLIFFE of Winnipeg, who has just been appointed C.N.R. trainmaster at Brandon, has entered upon the duties of his new position and is inspecting the lines west of Brandon, over which he will have control.

MR. MANLY B. BAKER, B.A., B.Sc., has been appointed Professor of Geology by the School of Mining, Kingston, succeeding Prof. R. W. Brock. Mr. Baker has been lecturer in geology at the mining school for the past three years and has proved himself a good teacher and well qualified to become head of the department. Mr. Baker is a native of Stratford.

MR. A. A. TISDALE, who has been connected with the Grand Trunk and Grand Trunk Pacific Railways in Montreal for some years, has just been appointed superintendent of the Lake Superior Division of the Grand Trunk Pacific. with headquarters at Fort William. Mr. Tisdale entered the service of the Grand Trunk about fifteen years ago as a junior clerk. Later he was appointed secretary to Mr. F. H. McGuigan, and afterwards assistant to Mr. W. G. Brownley, general transportation manager. Latterly he had been assistant to Mr. E. J. Chamberlin, vice-president and general manager of the Grand Trunk Pacific lines.

## OBITUARY.

MR. T. C. GREGORY, a civil and mining engineer, who was concerned in the building of the Great Western Railway, now merged with the Grand Trunk Railway, is dead.

It is announced that commencing with November 1 next, 773 engines and the Austrian State Railways will use liquid fuel, and probably in a short time liquid fuel will also be introduced on all the mountain railways, especially on the lines of Bregenz, Trieste, and Pontebu. The reasons assigned for the change are that the supply of coal to these lines is a very expensive item, and the damp atmosphere of the mountainous districts considerably lowers the calorific power of coal, the tunnels being soon destroyed by the smoke and gases produced, while the possibility of making an agreeable smokeless journey into these districts, it is hoped, will attract more tourists from abroad, and thus indirectly raise the profits of the State.

## QUEBEC RAILWAY.

The annual meeting of the Quebec Railway, Light & Power Co. was held last week.

Among the figures contained in the annual report, which show the remarkable progress of the company, were the following:—

| | |
|---|---|
| Gross earnings | $724,648 |
| Operating expenses | 444,300 |
| Net earnings | $280,348 |
| Interest on bonds and dividends on stock, paid | $240,046 |
| Surplus | $ 40,301 |

The surplus added to the surplus account advances its total credit to the sum of $462,947.

The directors were re-elected as follows:—Mr. W. G. Ross, president; Mr. Frank Ross, vice-president; Rodolphe Forget, M.P., William Price, M.P., the Hon. Senator R. Mackay, L. C. Marcoux, J. N. Greenshields, K.C., N. Belleau and Frank W. Ross.

## CALCARY STREET RAILWAY.

Calgary pay-as-you-enter municipal street railway system continues successful. The Labor Day receipts show that 19,023 passengers were carried during the day. The average daily receipts are now over the $400 mark. Six more cars are to be ordered.

## MONTREAL STREET RAILWAY

The earnings of the Montreal Street Railway for eleven months of the fiscal year show a surplus of $995,576, against $927,397 last year, an increase of nearly 7½ per cent. For the week ended September 18—Old Home week—the earnings were very large:

| | |
|---|---|
| 1909 | $87,521 |
| 1908 | 73,130 |
| Increase | $14,391 |

## TORONTO STREET RAILWAY

Gross and net earnings of the Toronto Railway Company for the month of August as well as the earnings for the eight months of the year to August 31st were:—

| | | Increase |
|---|---|---|
| Gross earnings, August | $ 333,223 00 | $ 33,290 10 |
| Net earnings | 167,166 54 | 16,859 65 |
| Gross earnings year to date | 2,477,310 22 | 202,183 60 |
| Net earnings to date | 1,211,245 80 | 188,638 71 |

Toronto Street earnings for the week ended September 18th, were:—

| | |
|---|---|
| 1909 | $79,109 |
| 1908 | 70,995 |
| Increase | $ 8,113 |

THE
# Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWAGE DISPOSAL.

### REMOVAL OF PUTRESCIBILITY*

### CHAPTER VI.

#### Percolating Filters

We have seen, that, the principal of the contact bed is based upon a false supposition. It was at first taken for granted, that, the actual work of breaking up the organic matters contained in sewage occupied a short space of time; and that, this space of time was represented by the period of contact. We have further seen, that, such is not the case; but, that, the period of contact is not occupied by biological action, but by a physical one of absorption. The organic matter is extracted from the sewage, and deposited on and in a gelatinous film which gradually covers the surface of the filter material. This physical action is succeeded by a biological one, only, after the liquid is removed from the filter, air taking its place.

The working of a contact bed may be summed up as follows:—

The Contact Bed{two processes} 1st physical—absorption. 2nd biological—nitrification.

In order to obtain the maximum working efficiency, it is necessary to maintain equilibrium between these two processes.

#### With Reference to the Physical Action

1st—Long periods of contact should be given, in order to obtain the requisite thickness of film ensuring the maximum absorption.

2nd—The periods of contact may be gradually reduced as the film increases (or the filter matures).

3rd—When the filter has arrived at full maturity, (viz., a maximum of organic matter is being absorbed) the period of contact may be reduced to a few (say five) minutes.

#### With Reference to the Biological Action

1st—With a new filter, very little matter is absorbed, consequently only a short time for nitrification is necessary.

2nd—As absorption increases, and more collected matter is to be oxidised, the period of aeration, or nitrification, must be increased proportionately.

3rd—When the filter is fully matured, and is absorbing a maximum of organic matter, then a period of aeration or nitrification, must be given to deal with the total amount of absorbed matter, otherwise the filter becomes clogged.

We have given briefly the data which exist relative to the above periods, gathered from experiments and observations made by the Royal Commission on sewage disposal, as well as those of Dr. Dunbar; of the Hamburg Institute of Hygiene. These data, although generally useful, point to a conclusion (already referred to) that, the proper, and most efficient working of any individual plant, can only be arrived at by local observations and experiments in connection with the plant in question.

Percolating Filter Bed.

Now, the question must naturally arise:—Does not the whole problem of the difficulty of maintaining equilibrium, lie in the separating of the two processes, viz., the physical and the biological ?

Let us ask ourselves the following questions:

(a). If oxygen is necessary to nitrification, why exclude it at any period?

(b). If filling a filter with sewage (as in the case of the contact bed) drives out all the air; why fill it ?

(c). If it is possible (with a mature filter) to absorb practically all the organic matters from sewage, in the space of a few minutes, then why not have oxygen present at the same time that this absorption is going on ?

The answer to all of the above questions is, the "Percolating Filter.

*These articles are specially prepared for this Review. by Mr. T. Aird Murray, Consulting Engineer, Toronto.

Santo Crimp and Dibden, when they made the "Barking" experiments, lacked information on three important points which have since been made clear, viz:

1st—The problem of even distribution of sewage over a filter, so that it came in contact with the whole of the filtering material.

2nd—A lack of knowledge of bacterial action as to when it took place.

3rd—No knowledge of the physical action of absorption, presented by the formation of the film.

The contact bed was the evolution of the lack of this knowledge. The percolating filter is the evolution of this knowledge.

The problem, at first, to be answered appeared a simple one. It was hypothecated, as a deduction from the Massachusetts experiments that, any sort of hard, broken material, arranged as a filter, would produce nitrification results at higher rates equally, or, even better than soil. The whole question to be settled was that of intermittent distribution. It was further taken for granted (as it was believed at Massachusetts) that the nitrification process took place immediately on the sewage coming into contact with the filter material.

Presumably, Santo Crimp and Dibdon said to themselves, "we will fill the whole of the filter area with sewage, so that every drop of the sewage will come in contact with the bacteria—become thoroughly nitrified—and pass off as a non-putrescible effluent." With the knowledge and data available at that time, such a deduction is understandable. The arrangement got over the whole difficulty of even distribution. It was simplicity in itself, ensuring absolute contact; and if the premises had been correct, a maximum efficiency would have resulted.

Of course, during all this period, when contact beds were accepted by many, as the final solution of sewage disposal, there were others such as Scott, Moncrieff and Professor Dunbar, of Hamburg, etc., who perceived the basic fallacy, and pointed to the necessity of thorough aeration and that, nitrification could only take place in the presence of air. Contact beds (if well looked after, and the equilibrium maintained) did their duty in producing non-putrescible effluents. This was, after all, just what was required of them. Results are what are looked to, and in most cases no one at first could complain of the results.

It was gradually found, however, that the good results at first obtained from contact beds developed diminution. Some way, or another, the equilibrium could not be maintained. The beds showed signs of clogging in many cases. The filtering material had to be washed or renewed or the beds given prolonged periods of rest. People, generally, began to ask themselves, if after all, this biological solution to the sewage question, was not like others in the past. "A great expense without finality."

Unfortunately, at first, exponents of the contact bed system, were carried away by enthusiasm. Too much was promised of bacterial action. It was held, that, even if raw sewage (from which the solids were not removed) was treated on such beds the whole sludge difficulty could be obviated. At Leeds, England, experiments in this direction were actually carried out; resulting, of course, in ultimate clogging of the beds. (See Royal Commission on Sewage Disposal—Fifth Report.)

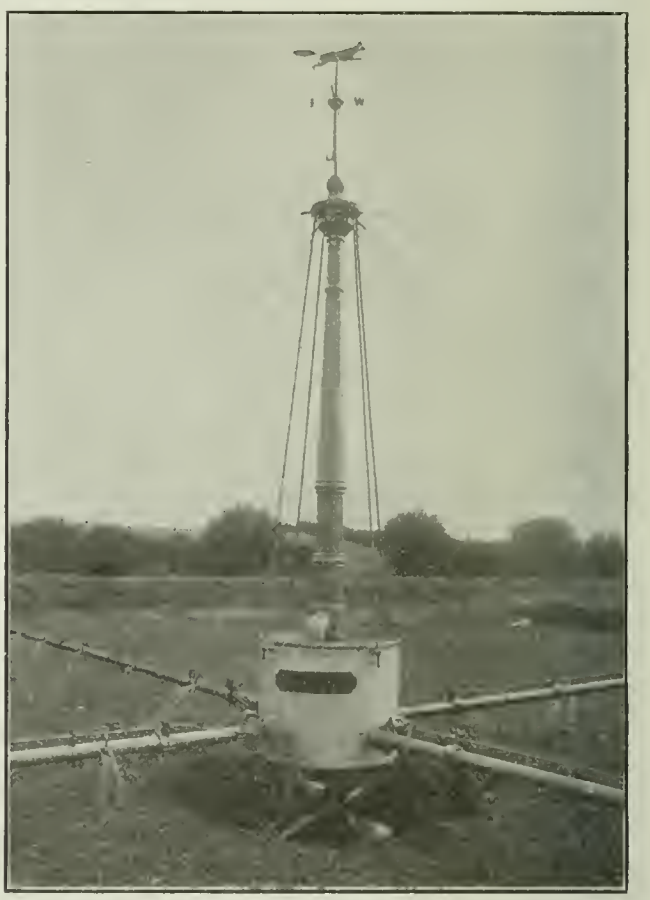
The same enthusiasm has been repeated, with reference to the septic tank treatment of solids. It was held, that, this process, finally, got rid of the sludge question.

Now, septic tank efficiency has dwindled down to a factor of 25% digestion or destruction of sludge (according to the Royal Commission) or 50% (according to German experiments). It has, further, been shown that septic treatment of solids is antagonistic to the ultimate production of a non-putrescible effluent by nitrification.

The septic method of treating solids has been combined with contact bed treatment. The combination being designated "anærobic," followed by "aerobic" treatment. The first (the anærobic) being applied to some putrefactive process by which the solids in sewage were said to be eliminated, and the second (the ærobic) by which the remaining constituents of the sewage are oxidised or nitrified.

One of the fallacies in the above combination, rests in the fact, that, there are provided anærobic conditions in both the septic tank and the contact bed; and, that, the decomposition of carbon compounds commenced in the septic tank are carried forward in the contact bed during the period of contact.

Now, it is easy to criticize after the event, and proclaim the reasons why the contact bed has not fulfilled its many promises; but, are we going to claim for the percolating filter all these promises which were at first adduced in favor of the contact bed. We trust not. The percolating system of biological sewage disposal, no matter with what preliminary system of removal of solids it is combined, does not get rid of the sludge difficulty. The sludge, like the poor, is always with us. In fact the maintenance of a continued efficiency in producing a non-putrescible effluent by means of a percolating filter, depends upon the thoroughness of the preliminary method of removal of solids from the sewage.



**Sprinkler.**

The main features of the percolating filter as compared with the contact bed are as follows:—

1st—The filter is never in a condition of liquid saturation.

2nd—At no period is air excluded from the filter.

3rd—Absorption of the organic matters from the sewage, by virtue of the film formation is continuous.

4th—Nitrification of the absorbed organic matter is continuous.

5th—The physical action of absorption and the biological action of nitrification are carried on simultaneously.

We at once see that the chief difficulty in working the contact bed, viz., the timing of the periods of contact and aeration, is overcome, as the two actions are carried on together. It must, therefore, become a question, as far as efficiency is concerned, not so much in the working of the filter as in the sufficiency of the area to provide (a) the necessary amount of superficial area of material to present a scum surface capable of absorbing practically all the organic matters (b) the necessary area and porosity of the material for the growth of the nitrifying organisms to keep pace with the absorption. Given these two factors in proportionate com-

bination, and equilibrium as between the physical action and the biological one should be maintained.

Efficiency must, however, also depend upon the method of working and application of the sewage to the filter, as for instance, (a) Even distribution of the sewage over the whole surface of the filter, (b) That the sewage be not presented in the form of bulk, but broken up into drops or spray, (c) The porosity be of an open character, that the drops of sewage will not fill the pores to the exclusion of air, (d) That the passage of the drops of sewage through the filter be sufficiently slow, to give ample time for the absorptive film to extract from each drop of sewage the organic impurities contained, (e) That the liquid supplied to the filter never is under pressure, beyond the gravity inherent to each independent drop, so that there is no flushing of the filter.

If due consideration be given to the above points, percolating filters may be constructed which will perform efficient duty for terms of from 10 to 15 years without it becoming necessary to cleanse the filtering material.

The above points will receive further consideration in detail in following issues.

(To be Continued.)

## SOME PROBLEMS IN CIVIC HYGIENE.

Good building and good inspection are so closely connected with hygiene and sanitation that a building department should work in harmony with the sanitary; indeed, they should be combined. There is more than the mere economic aspect. For instance, if weak cement is used in the concrete foundation, or not enough or an inferior grade of mortar in the case of a stone foundation, presently the structure is in an unsound and consequently unsanitary condition. Plumbing becomes unstable and develops defects. This applies to drainage also, all leading to complications affecting health, besides providing harbor for vermin; the latter are recognized as carriers of disease, as they transmit filth to food-stuffs and so to the occupants.

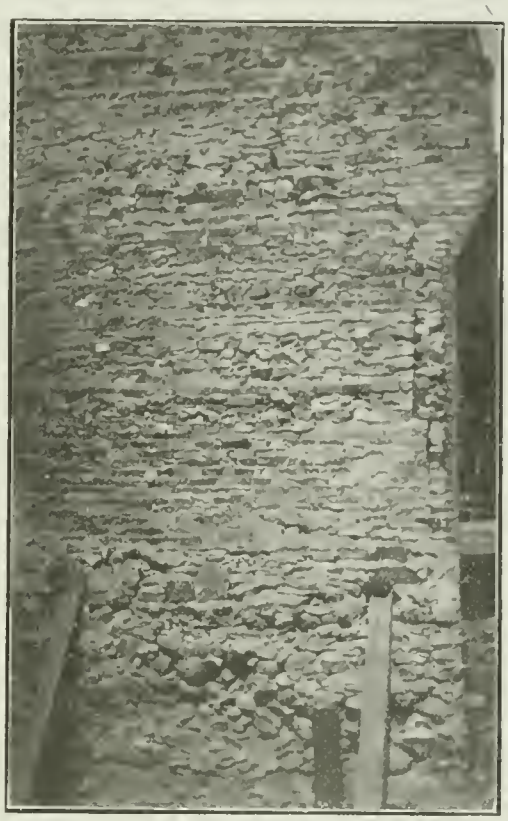
The accompanying illustration from a photo taken in one of the poorer districts of Toronto, just now being cleared for the new General Hospital, provides interesting material

**Stable, Seven Feet From Cottage Door.**

for study in this connection. It shows the side-wall of a story and a half building. This wall was built flush with another building, the removal of the latter exposing defective masonry and foundation work. Bricks are in every conceivable position, and with little or no mortar to hold them. A portion of the stone foundation was so bad that it evidently fell out in a heap when the neighboring wall was removed. The props have been placed in position as a belated, but somewhat useless, measure of safety. The building had evidently been built not more than three or four years. A wall of this description might readily cause an accident similar to the one which occurred but a short distance from this spot, in which a young man working on the building was killed by the falling bricks.

Another source of unhygienic conditions is newly built up land. This is altogether apart from any odors or gases arising from the land, or from contamination of water in wells, etc., the conditions arising being very similar to those which have just been described. The structure settles and develops fissures and cracks and breakages, and soon becomes a menace to health.

Infrequent inspection during the process of building opens up the way for all sorts of abuses of the building by-laws. Even after the general construction is finished there are the location of stables, privies and outhouses to look after. These are often placed in the closest proximity to the



**Faulty Masonry.**

rear and even to the front of the house, especially in the poorer districts, as this photo, taken on Centre Avenue, Toronto, will show. This photo shows a couple of cottages in the rear of dwelling houses and stores, making the conditions immensely worse than where located in the usual way along the street. To the left is a horse-stable within six or seven feet of a cottage door. Horse manure is well-known to be the favorite breeding place of the house-fly, which has been well named "the typhoid fly.". The danger of these breeding places to all sections of the city is apparent when we consider that the fly walks over filth of all kinds and may then fly direct to the table of the rich as well as the poor, in this way carrying and disseminating the bacteria of disease.

Strangely enough, even the classes who appreciate the value of cleanliness are not awake to the disease carrying propensities of the house-fly and take both insufficient precautions for keeping the fly from foods of various kinds and also in many cases fail to realize that they are providing a breeding-place for the fly at their own back doors in the uncovered garbage cans, which are so frequently found. Lack of information as to the habits of the "typhoid fly" is responsible for this; but what can be expected when the civic garbage department itself provides for a collection only twice a week in the hottest kind of weather, leaving plenty of time for fly reproduction, and also for the garbage to become fermented and putrid.

Rats and mice, which harbor in rickety, badly constructed buildings, have long been recognized as carriers of disease, but there is evidently room for a well-directed campaign against the fly, as well as against other vermin which infest the house. It would be easy to show, in this connec-

tion, that an immense saving could be effected for the city as well as for the householder, not to mention a probable decrease in the number of deaths throughout the season.

The back-door is the trouble. This is the fountain-head of civic ills, not the front door. Cut No. 3 illustrates this very nicely. The parks and the streets are important adjuncts to public health and enjoyment, but fail entirely to make amends for neglect elsewhere. In cut No. 3 we have the uncovered garbage receptacle, as well as rubbish scattered

**A Back-yard in "The Ward."**

about promiscuously. At the right-hand side of the illustration we have the same conditions. A food receptacle projects from the window. This is rickety and allows a free entry of flies.

It is a mistake to think that it is "only a dirty foreigner." In the first place filth is international. It is of no particular nationality. There are ignorant and dirty people of every race under the sun. It is also a mistake to think that the effects of civic neglect and ignorance can be isolated. The result of every blunder of this sort permeates the whole community, consquently the need for action.

**No. 4.—Filthy Gutter.**

The importance of attention to street cleaning is shown in illustration No. 4. The street is the playground of the child, and the only hope for the future of any city is proper consideration for the health, recreation and education of children, not to mention the claims of the adult to comfortable and hygienic conditions.

In making the investigations which form the subject of this article, filthy back yards were the common thing, and, as stated before, it improves matters very little by stating that this was one of the poorer districts. There should be no filthy districts in a well-managed municipality. Bakeries and butcher-shops galore were found in the closest companionship with stables and rubbish heaps, street-corner ice-cream also figurel in the proceedings, as quite a number of carts and equipments were found in the vilest surroundings, showing that the outcry against these is by no means unwarranted.

Serious as the subject may be, it seems that little in the way of improvement will be accomplished until our authorities themselves appreciate the necessities of the situation.

## ECONOMICAL DEVELOPMENT OF WATER POWER.

The large number of water power developments examined by Charles T. Main, mill engineer and architect, of Boston, a very large percentage have been developed with wheel capacity sufficient to use all of the water from six to seven months in an average year, and during the remaining months water would go to waste. The period of economical development varied with each particular case; in some instances it was stated by engineers to be nine months. It is this variation which complicates the problem of the economical development of water power.

Mr. Main shows that the factors which enter into the problem are on one side the cost of the water power development and the fixed charges on the same, plus the cost of water if anything is paid for it, and on the other side the saving which can be effected by the use of such a plant.

The cost of the dam will be a constant for any size of wheel development, other things being equal. The head gates, canal, racks, feeders, wheels, wheel-pits, and tail-races must be increased in size and cost for the purpose of using a larger amount of water than the flow in the average month or six months of an average year, and the fixed charges for such increase in cost, plus the cost of water, represent the annual cost of the corresponding increase in water power.

The saving due to such increase in water power is represented by the saving in coal on supplementary steam plant, necessarily run with such a varying water power, plus the cost of attendance and supplies on steam plant if it can be shut down entirely during the months of maximum power on the wheels. As the water power is increased in size to use water for a greater number of months, the cost of such increase for each additional month makes a saving for a less number of months, and there comes a time when the saving on steam power is less than the fixed charges on the additional cost of water power plant. Where these two items balance depends upon the following conditons:

(1) Cost of running the water power plant for each increment of power.

(2) Saving effected by the decreased use of steam power.

The variation in the cost of the water power plant per horse-power is very large. The principal causes for this are the variation in head and distance from the source of supply of the water to the point of discharge. The cost of construction will also vary with local conditions.

The saving effected would also vary largely, depending principally upon the number of hours run during the day, the cost of coal, and whether by increasing the size of water power plant the auxiliary power plant could be stopped during the months in which the water power was producing full load.

At the end of 1908 the miles of electrified steam railroad track in Great Britain worked solely by electricity was 204½, and partly by electricity 200½.

# LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

**[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]**

## DEFECT IN WHEEL.

**Caiser vs. Niagara, St. Catharines, etc., Ry. Co.**—It appeared that in May, 1908, the defendant company took a number of their cars after being laid up for the winter and sent them out with an excursion party, and it appeared also that the defendant company made no careful or particular examination of the wheels before putting the cars in use. The cars were heavily loaded, and when proceeding slowly around an easy curve the flange on one of the hind wheels broke, causing a derailment and throwing the plaintiff from the car and causing her serious injury. An examination later showed that the flange broke because of a defect in the shape of an airhole, such defect having existed at the time of the manufacture.

The company were unable to show that their employees really did anything in the way of testing the wheels except to cast an eye upon them to ascertain that they looked all right; but, of course, the kind of defect in question could not be detected by an ocular inspection, but a professional inspector stated that tapping would disclose a blow-hole in a cast iron wheel if close enough to the surface to break through, which was what happened in this case. The company were held liable for the damage sustained.

19 O.L.R. 31.

There is a distinction in the degree of responsibility for apparent defects and for latent or hidden defects. The company would be in any case responsible for damages arising through running their cars with apparent or open defects, for the mere fact of using an appliance with an obvious defect is proof of negligence, but the defect shown in this case was a hidden one and difficult to detect even considering reasonable skill or diligence had been used. It was not the existence of the defect but the fact that the company failed to discharge their duty of examining the equipment thoroughly and skilfully, which rendered them liable, and had the wheels been given a careful mechanical inspection prior to being used, the company would have avoided responsibility.

## FENCING OF RAILWAY.

**Cortese vs. C.P.R.**—Section 254 of the Dominion Railway Act provides that wherever the railway "passes through any locality in which the lands adjoining are not inclosed and either settled or improved, the company is not required to erect or maintain fences, gates, etc." along its line.

The plaintiff Cortese was owner of a ranch the north limit of which approached within 800 yards of the limits of the Town of Fernie, B.C., and also his lands had a frontage of 450 feet upon the defendant's right of way.

In August, 1907, a number of animals owned by plaintiff got onto the railway track and were killed by the defendant's train, and the plaintiff claimed compensation, saying that the company were bound to fence their track. The defendants disputed liability upon grounds that the lands adjoining their line were not "enclosed or improved" within the terms of the statute, and that therefore there was no duty upon them to protect their line by fencing. The evidence showed that the plaintiff's ranch had only one short fence upon it, and that other lands between the ranch and the town were mostly sold off in small lots, but only occasional lots were built upon or fenced. The statute does not say that the mere proximity to the town should cast upon the railway company any duty to fence its line, and the court exonerated the company.

13 B.C.R. 322.

## FIRE FROM LOCOMOTIVE—RAILWAY RESPONSIBLE.

**Fraser vs. Pere Marquette Ry. Co.**—Section 298 of the Railway Act provided that "wherever damage was caused to crops, . . . . plantations or buildings and their contents by fire started by a railway locomotive, the company, whether guilty of negligence or not, should be liable for such damage." The plaintiff was the owner of certain marsh lands, which lands were not close by the line of the defendant company, but lay some miles distant from it. He had cured and baled a considerable quantity of marsh hay and brought same to a siding, at Wallaceburg, Ont., where it lay upon the ground awaiting shipment to the purchaser, and, while lying thus, it was burned by fire undoubtedly from a locomotive. The plaintiff claimed that the baled hay was within the terms of the above section, and brought action for the value of the hay lost. The Ontario Court of Appeal has recently given judgment, holding that the plaintiff's hay was not within the terms of the above section. The grass upon the plaintiff's land had undoubtedly been included within the general term "crop," but after being cut, cured, baled and sold, and indeed, transported, a number of miles on its way to the purchaser, the court held it had ceased to be "crop" and was now merchandise. There was therefore nothing in the Act which would cover the hay unless it had been stored in a building, which was not the case. The court also commented on the fact that whereas the act was no doubt passed for the protection of property owners along the line, this hay was grown upon lands a considerable distance from the railway and entirely outside the danger zone.

18 O.L.R. 589.

Had the plaintiff shown that the fire occurred by negligence of the company, he could, of course, have succeeded anyway, but the plaintiff made no allegation of negligence, merely saying that the fire started from a locomotive. He claimed that he was within the particular class provided for by section quoted above, but as he failed to prove that the claim was within that class, he failed altogether.

The statute has been changed at the last sittings of the Legislature, so that now it includes **any property.**

## HAZARDOUS EMPLOYMENT—UNSKILLED WORKMEN.

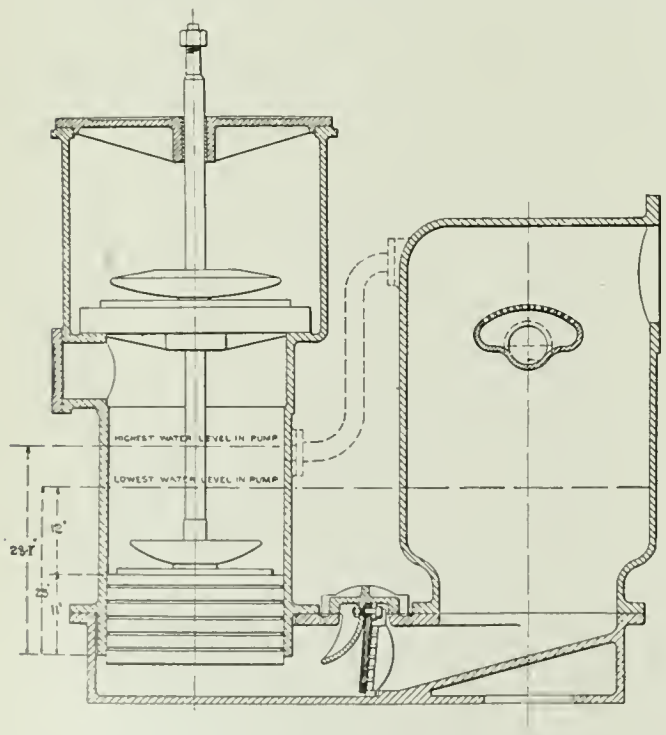
**Linden vs. Trussed Concrete Steel Co.**—The defendants, who were contractors for the erection of an eight-story building in the City of Toronto, used an outside hoist for the purpose of raising materials required in the construction of the different floors. This hoist stood close to the building, and was built in sections as floor after floor was added to the building. When the roof section of the building was reached the last section of the hoist was commenced, and the foreman sent up two skilled carpenters accustomed to working on high buildings, and, as they wanted an assistant, he sent up also a laborer, named Linden, to hand material to them. The workmen proceeded by placing a platform, about eight feet square, to form a floor, upon which they worked while erecting the uprights and adding the braces outside the uprights. They had placed this platform and were busy with the braces, but had not placed any temporary railing or guard rope around the platform, when

the laborer, handing material, stepped onto the platform, tripped and fell forward, pitching beyond the platform and receiving injuries from which he died next day. His widow brought action for damages suffered by reason of his death.

The jury found that it was negligence on the part of the contractors to omit to have a guard rail or rope around the small platform upon which men were expected to work at such a distance from the ground, and entered a verdict for the plaintiff. It was held also that a different degree of care was necessary as between the skilled workmen and the laborer. The former were accustomed to such work, and, in fact, made it their business, and while the work was not unusually hazardous to them, it must be considered as such to the laborer, accustomed to working on larger floors and near the ground. Reasonable prudence should have suggested that it was hazardous to order him to work at such a height, and all due precautions should have been taken for his safety. 17 O.L.R. 540.

## NOTES ON VERTICAL AIR PUMPS.

The following paragraphs were written to draw attention to a point which is almost universally overlooked in designing the vertical single-acting air pumps generally applied to factory engines. The writer's attention was first drawn to it when trying to find out the cause of a bad vacuum in the condenser of a tandem horizontal compound engine, developing about 500 I.H.P. at a speed of 60 revolutions per minute. The air pump, vertical and single-acting, 2-ft. diameter by 2-ft. stroke, was driven by bell-crank lever and links from the piston rod crosshead. The vacuum in the condenser varied from 9.8 lbs. to 10.3 lbs. per square inch.




The temperature of the injection and discharge were 108° and 136° respectively. The pressure in the condenser was, therefore, from 2.3 lbs. to 1.8 lbs. higher than the pressure of saturated steam at the temperature of the discharge. This variation, as well as the great difference between the observed and saturation pressures, naturally suggested leakage of air into the condenser, but no leak could be found, nor were more air bubbles than usual visible in the discharge. The foot and delivery valves were in order, and the bucket valve, though not seen by the writer, was said by the engineman to be in order. Some other cause, therefore, had to be sought for. A drawing of the pump (see Fig. 1) supplied the clue. The bucket, to use words inserted in many modern specifications, was "a plain cast-iron bucket of great depth," with the valve on the upper surface, which, when the bucket was in its lowest position, was 11-in. above the bottom of the barrel.

Moreover, the clearance space between the delivery valve and the bucket valve when the latter was in its highest position was very large, containing sufficient water to fill the barrel of the pump to a height of 12-in. The lowest level of the water surface in the pump, and in the condenser, unless the pressure in the latter exceeded that in the pump, was therefore 23-in. above the bottom of the pump, and the condenser was water-sealed.

Now, it is well-known that even when all glands, joints, and drain taps are absolutely tight, air is carried into condensers with the injection water. If the condenser be water-sealed, how can this air escape? Some of it is entangled in the water in the form of bubbles, and is carried through the foot valve with the water, but the rest must remain in the condenser until its pressure becomes sufficient to force the water seal. If in the case referred to the depth of the seal had been only 23-in., the seal would have been forced and the air would have escaped as soon as the pressure in the condenser exceeded the pressure in the pump by an amount equal to this head, or, in other words, the vacuum would only have been 0.83 lbs. per square inch worse in the condenser than in the air pump. Unfortunately, the depth of the seal was limited to 23-in. only when the engine was standing. When it was working the pump had to discharge 1.43 cubic ft. of water every up-stroke, a quantity sufficient to raise the water surface in the pump 5.7-in. above its lowest level, or to 28.78-in. above the bottom of the barrel. And this is not all. To force water through a foot valve the head of water, or the pressure on the condenser, must exceed that in the pump by an amount depending on the resistance of the passages and the rate of flow required. In the pump shown by the figure the net area through the foot-valve grid was 0.67 sq. ft. The effective area, allowing for contraction caused by the sharp edges of the holes, would probably be about 0.4 sq. ft. The time of one revolution was one second. Assuming for the moment the foot valve to have been open, and the velocity through it to have been uniform for two-thirds of this period, that velocity would be 5.4 ft. per second, and the head required to impart it 5.5-in.

But it is quite certain that the velocity was not uniform, for the flow was greater while the bucket was ascending than while it was descending, and ceased altogether while the foot valve was shut. The maximum velocity was probably not far from double the mean, and therefore the head required to give it four times as great as that required to give the mean, that is to say, about 22-in., instead of 5.5-in. So that, roughly, the conclusion seemed to be that if the pressures in the condenser and air pump could have been kept equal, the water surface in the latter would have stood approximately from 28.7 + 5.5 = 34.2-in. and 28.7 + 22 = 50.7-in. above the bottom of the air-pump barrel.

The pressures required to force water seals of these depths would be 1.22 lbs. and 1.8 lbs. per square inch. Under such conditions the vacuum would naturally vary, rising whenever the water seal was broken and falling as the water and air pressure in the condenser rose. The argument shows the influence of the relative levels of the bucket valves and foot valves, and the areas through the latter upon the vacuum in the condenser.

As regards the former, it may be asked, Why not put the bucket valve at the bottom instead of the top of the bucket? The answer is because the change would increase the clearance space between the bucket and delivery valves, and therefore the volume of air bubbles left in the upper part of the pump at the beginning of the down-stroke of the bucket. It would also reduce the ratio of expansion, and therefore the vacuum obtainable in the pump.

Suppose the bucket valve were placed at the same level as the bottom of the bucket shown in the figure. The volume above the bucket at the beginning of the down-stroke, or the

*From the report of M. Longridge, M.A., Chief Engineer British Engine, Boiler and Electrical Insurance Company, England.

clearance space, would then be about 5.5 cubic ft. At the end of the down-stroke this space would be increased by the displacement of the bucket 6.2 cubic ft., and diminished by the volume of water flowing through the bucket valve per stroke, 1.43 cubic ft., giving a net increase of 4.85 cubic ft., which, added to the clearance, gives a total volume of 10.35 cubic ft. Suppose the water left in the clearance when the bucket begins its down-stroke to contain 5 per cent. of air bubbles. Then the clearance, 5.5 cubic ft., will contain 5.2 cubic ft. of water and 0.3 cub. ft. of air at atmospheric pressure. When the bucket has completed its down-stroke, the 0.3 cubic ft. of air will have been increased to $10.35 - 5.2 = 5.15$ cubic ft., and since the expansion will be isothermal, the pressure will have fallen from 15 lbs. to $15 \times \frac{0.3}{5.15} = 0.875$ lbs. per square inch. If, however, the clearance, instead of being 5.5 cubic ft., were reduced to 1 cubic ft., and the final volume $4.85 + 1 = 5.85$ cubic ft., then the volumes of air and water in the clearance at the beginning of the down-stroke would have been 0.05 and 0.95 cubic ft., and the pressure at the end of the down-stroke $15 \times \frac{0.5}{5.85-95} = 0.153$ lbs. per square inch.

That is to say, by reducing the clearance from 5.5 cubic ft. to 1 cubic ft., the vacuum produced by the air pump would be improved by nearly 0.73 lbs. per square in. In neither of these calculations has account been taken of the air brought into the pump with the 1.43 cubic ft. of water which passes through the bucket valve during the latter part of each down-stroke, as this, being the same in each case, would not alter the difference between the calculated final pressures.

As the vacuum in the upper part of the air pump is the limit to which the vacuum in the condenser can approach more or less nearly, but never reach, this speculation indicates the importance of keeping down the clearance, especially when the injection water contains much air or gas. It also suggests the reason why an air pump running few revolutions per minute produces a better vacuum than one running many, for the fewer the revolutions the less the quantity of air that must be let into the top part of the pump to prevent or to mitigate the shock when the water strikes the delivery valve.

Even in this pump the vacuum ought to be improved by leading a 3-in. or 4-in. pipe from the top of the condenser to enter the air-pump barrel at about the highest water-level, as shown in dotted lines on the figure, but the better plan would be to design the pump somewhat as shown in Fig. 24.

There is no urgent reason for making buckets without packing rings of great depth for vertical pumps, for it is not necessary that they should be absolutely tight. There must be a certain depth at the central boss in which the rod is fixed, in order to give depth and strength to the ribs or arms, but at the circumference a depth of 2-in. or 3-in. would probably be found sufficient.

The pistons of horizontal air pumps not being water-sealed are more efficient with packing rings to prevent air passing from one end of the pump to the other when the pistons wear down.

## EARTH ROADS.*

**By Maurice O. Eldridge, of the United States Office of Public Roads.**

The cost of hauling over country roads is largely determined by the size of the load that can be hauled, the number of trips that can be made in a day and the wear and tear on teams and equipment. Steep grades as well as ruts and mud holes serve to decrease both the speed and the load. On the principal that a chain is no stronger than its weakest link, the maximum load that a team can draw is the load that it can draw up the steepest hill or through the deepest mud hole on that road.

Wherever possible roads should be located on straight lines between terminal points. In hilly or mountainous country, however, the attempts to keep roads straight between terminals often leads to the serious error of heavy grades. Straightness and grade must therefore be handled together. The best location is one which is straight in general direction, is free from steep grades, is located on solid ground and serves the largest possible number of people.

Roads should be located for the benefit of the people and not the private land owner. If county officials would apply to each badly located road some simple formula like the following they would be justified in relocating many roads. For example: The diagonal road on a 160-acre tract is .70 mile and saves .30 mile in going around it. Assuming 3,000 tons of traffic and a cost of 25c. per ton per mile, the public would save $225 by the short route. This is enough to pay the interest and sinking fund on at least $4,000, which would be sufficient to pay for the whole farm at $25 per acre. The $225 alone would in most cases pay the damage and in many other cases there would be no damage. If the short road is on a better grade than the long one the saving would be still greater.

The elimination of one or two steep hills on a line of road will frequently enable horses to draw three or four times as much as they could draw on the old road. It takes approximately four times as much power to draw loads up 10 per cent. grades (10′ vertical in 100′ horizontal) as on a level, but on a 4 per cent. or 5 per cent. grade a horse can usually draw (for a short time) as much as he can draw on a level. A 4 per cent. or 5 per cent. grade is, therefore, considered the maximum on roads subject to heavy hauling. Many steep grades may be avoided by locating the road around instead of over the hill, and it is often no further around than a hill than over it—the bail of the bucket is no longer when held in a horizontal position than in a vertical. By going around we avoid two steep hills.

If the road must pass up a steep hill or mountain side the steepness of the grade may be decreased by increasing the length of the road. In other words, eliminate steep grades by locating the road on curved or zig-zag lines, and not in a straight line from the bottom to the top of the hill. These curves should be carefully plotted and the straight stretches located with an instrument. This improves the looks of the road and does not add materially to its cost.

In studying the relation of grade to distance the following calculation is interesting: To lift a ton one foot high requires 2,000 foot pounds of energy; on a road the surface of which offers 100 pounds of tractive resistance per ton the same energy would roll the ton a horizontal distance of 20 feet. To save one foot of grade the road may therefore be lengthened 20 feet.

Roads should never be located so close to stream beds as to be subject to overflow, or on ground which is constantly damp and marshy.

The earth road should have at least six hours of sunshine each day. This can be secured either by locating the road with southern or western exposure, or by having such brush and trees as impede the drying action of the sun and wind removed. With gravel and stone roads, this is not so necessary, as a certain amount of moisture is needed on such roads, especially in the summer time.

Re-locating roads is not an engineering problem alone. One must also consider the effect of the road on those who now live upon it. Many farmers dislike to have the road placed back of their houses or out of sight of it. It requires tact and good judgment to secure a suitable location without arousing harsh antagonism.

As soils differ for agricultural purposes, so they differ for roads. Clays or soils of fine texture usually make poor

* From a paper read at the First American Congress of Road Builders, Seattle, Wash., July 4-8, 1909.

roads, especially if they contain much vegetable matter. The coarser soils, however, which contain some sand or gravel, will often make very satisfactory roads for light traffic provided they are kept in proper repair.

If the road is composed of fine clay or soil it will sometimes pay to resurface it with top soil from an adjacent field which has sand or gravel mixed with it. This method, called the top soil method, is now in successful use in Clarke County, Georgia.

The earth road can best be crowned and ditched with a road machine, and not with picks and shovels, scoops and plows. One road machine, with suitable power and operator, will do the work of many men with picks and shovels, and do it better.

The road machine should be used when the soil is damp, so as to make the soil bake, when it dries out. If it is worked dry, it takes more power to draw the machine, and, besides, dry earth and dust retain moisture and quickly rut after rains. The use of clods, sods, weeds or vegetable matter in building earth roads should be avoided because they retain moisture.

It is a great mistake to put the working of the earth road off until August or September. The surface is then baked dry and hard. It is not only difficult to work, but is unsatisfactory work when done. Earth which is loose and dry will remain dusty as long as the dry weather lasts and then turn to mud as soon as the rain begins.

By using the road machine in the spring of the year while the soil is soft and damp the surface is more easily shaped and soon packs down into a dry, hard crust which is less liable to become dusty in summer or muddy in winter.

Storm water should be disposed of quickly before it has time to penetrate deeply into the surface. This can be done by giving the road a crown or slope from the centre to the sides. For an earth road which is 24 feet wide the centre should be not less than six inches nor more than twelve inches higher than the outer edges of the shoulders. A narrow earth road which is high in the middle will become rutted almost as quickly as one which is too flat, for the reason that on the narrow road all the traffic is forced to use only a narrow strip.

Shoulders are often formed on both sides of the road which prevent storm water from flowing into side ditches, retaining it in the ruts and softening the roadway. These ruts and shoulders can be entirely eliminated with the road machine or split-log drag.

Ordinarily, the only ditches needed are those made with the road machine, which are wide and shallow. Deep, narrow ditches wash rapidly, especially on steep slopes, which is another good reason for decreasing the steepness of the grades. It is difficult to maintain an earth, or any kind of road for that matter, on a steep grade.

The width of the earth road will depend on the traffic. As a rule, 25 or 30 feet from ditch to ditch is sufficient, if the road is properly crowned. A road that is narrower than 25 feet is difficult to maintain for the above stated reason that on narrow roads the teams are more apt to track than on a wider road, causing it to rut if subjected to heavy hauling.

We should not loosen, dig up, or plow up any more of the surface of an eath road than is absolutely necessary. The road should be gradually raised, not lowered; hardened, not softened.

On flat lands, where water moves slowly, grading material should be taken from the lower ditch, and culverts supplied where waterways occur. A shallow ditch on the upper side makes it possible to give culverts a good fall. Two or more small pipes, instead of one large one of equal capacity, may be used for culverts, especially if the large pipe necessitates much grading or raising of the roadway. At least six inches of space should be left between the pipes, and earth should be tamped around them thoroughly so as to prevent a wash-out.

To prevent washing on steep roads, the water should be carried under the surface at frequent intervals from the upper to the lower side, and from the lower side away from the road. Five 12-inch pipes in a mile of roadway is about as cheap and far better than one 24-inch pipe. The water must be disposed of before it gains force or headway, or has time to damage the road.

If culvert pipes have a fall of one inch to 100 feet, the water passing through them has a velocity of about four miles an hour, but if the fall is 36 inches to 100 feet, the velocity is about 20 miles per hour, hence, a pipe laid upon a fall of 36 inches to 100 feet will have five times the capacity of a pipe of equal diameter laid on a grade of one inch to 100 feet. A 24-inch pipe, having a fall of one inch to 100 feet, will have a capacity of 3,296 gallons per minute, whereas a 12-inch pipe, having a fall of 36 inches to 100 feet, will have a capacity of 2,554 gallons per minute.

By increasing the fall, we increase the capacity of the pipe; decrease the size of the pipe necessary, and therefore decrease the cost of the culverts. Furthermore, culverts laid flat will soon fill up, but if given a good fall, they will keep themselves clear.

If much fall is obtained in a culvert pipe, the spillway should be paved. Earth should be tamped under and around the pipe in layers, and should be of sufficient depth to prevent the pipe from being broken by traffic; but under no circumstances should a ridge over the culvert be allowed, for it not only endangers the life of the culvert, but is a menace to traffic.

An attempt to drain mud holes with culvert pipe will fail in most cases. The water should be drained off by means of open ditches; the soft mud then thrown out and replaced with just enough good firm earth to make it level, after consolidation, with the surrounding surface. If mud holes in earth roads are filled with brush or stone, it usually results in two mud holes, one at each end.

Repairs should be made when needed, and not once a year after the crops are "laid by." One hundred days' labor, judiciously distributed throughout the year, will accomplish more and better work in the maintenance of an earth road than the same amount of labor expended in six days, especially if the six days are in August, September or October, when the ground is hard and dry.

Because of its simplicity, its efficiency and cheapness, the split-log drag, or some similar device, is destined to come into more and more general use. With the drag properly built and its use well understood, the maintenance of earth and gravel roads becomes a simple and inexpensive matter. Care should be taken to make the log so light that one man can lift it with ease, as a light drag responds more readily to various methods of hitching and the shifting positions of the operator than a heavier one.

The best material for the drag is a dry cedar log, though elm, walnut, box elder or soft maple are excellent. Oak, hickory, or ash are too heavy. The log should be from seven to ten feet long, and from eight to ten inches in diameter at the butt end. It should be split carefully as near the centre as possible and the heaviest and best slab chosen for the front. Holes are then bored perpendicular and at right angles to the split faces and in such a way that one end of the back slab when fastened in position will be about sixteen inches nearer the centre of the road than the front one. This gives the "set back" so that the logs will track when drawn along the road at an angle of about 45 degrees. The two halves of the logs are fastened together by stakes, these being mortised into the holes above mentioned. A cleated board is placed between the slabs for the driver to stand on.

A strip of iron placed along the lower face of the front slab will prevent the drag from wearing. The drag may be fastened to the double tree by means of a trace chain. The chain should be wrapped around the left hand or rear stake and passed over the front slab. Raising the chain at this end of the slab permits the earth to drift past the face of the drag. The other end of the chain should be passed through a hole in the opposite end of the front slab and held by a pin passed through a link.

For ordinary purposes the hitch should be so made that the unloaded drag will follow the team at an angle of about 45 degrees. The team should be driven with one horse on either side of the right hand wheel track or rut the full length of the portion to be dragged and made to return in the same manner over the other half of the roadway. Such treatment will move the earth toward the centre of the roadway and raise it gradually above the surrounding level.

The best results have been obtained by dragging roads once each way after each heavy rain. In some cases, however, one dragging every three or four weeks has been found sufficient to keep a road in good condition.

When the soil is moist but not sticky the drag does its best work. As the soil in the field will bake if plowed wet, so the road will bake if the drag is used on it when it is wet. If the roadway is full of holes or badly rutted, the drag should be used once when the road is soft and slushy. This is particularly applicable before a cold spell in winter, when it is possible to so prepare the surface that it will freeze smooth.

Not infrequently conditions are met which may be overcome by a slight change in the manner of hitching. Shortening the chain tends to lift the front slab and make the cutting slight, while a longer hitch causes the front slab to sink more deeply into the earth and act on the principle of a plow.

## TAR AND ITS USES IN MODERN ROAD CONSTRUCTION.*

**By E. Purnell Hooley, M. Inst., C. E., County Surveyor of Nottinghamshire, Eng.**

The question, How to construct roads at the minimum of present and future expense, will be best answered by a paper entitled "Tar and Its Uses in Modern Road Construction."

It is not here proposed to enter into any detail of general road construction. Other writers will, and have, doubtless dealt as specialists in the many branches of the road question, but there is little doubt all will unite in agreeing that good roads are absolute necessities in the advancement and development of a progressive country, and that without good roads it is impossible to advance.

By roads in this case all roads, be it waterways, railways, horseways, are embraced, but for internal development and progress the ordinary highways must be the actual nerves that bring in touch the general internal public with with the outside world.

In England the maintenance of highways has become of such importance that hardly a day passes without some new proposal being made for dealing with the cost of management of the same.

Broadly, at present, all the existing English main roads are vested in the county councils. The urban and rural councils have the care of the branch of district roads. New roads have to be made by private individuals, and have to be thoroughly well constructed and properly dedicated before they are taken over by the local public authorities.

This paper is to deal with ordinary country roads, not town streets.

The question now is, how best to repair the existing roads, and America has the experience of England to guide her in the matter of expense, trouble, and very possibly avoid defeat, by carrying out modern ideas in laying out and constructing new roads on the very best and up-to-date systems, rather than having to patch up and undo the failures and disasters that the ratepayers of England are so loudly grumbling about, in the present high rates they are called upon to pay.

Roads without proper foundations are the most expensive and disappointing to deal with, but to re-form the foundations of all the roads, 27,600 miles of main and possibly 92,300 miles of district roads of England, say one hundred and twenty thousand, would cost a sum so large that it is outside the bounds of possibility to even think of.

The general practice of all thinking road engineers now seems to be, to treat the present roads as the foundations upon which to build roads of a permanent character.

In America it surely must be the only wise course to thoroughly construct new roads for the sake of the present and future road users.

Leaving all questions of foundations to be dealt with by other writers with the general proviso that all roads should or must have foundations, the writer will turn his remarks to surfacing.

Where roads have a first-class face, and it is possible to tar-wash that face at least once every four months at a cost of about 3 cents per square yard, tar as a surface binder will undoubtedly be a success in temporarily holding the surface of an ordinary macadam road together, but there its help and benefit ends. It will not make a weak road, subject to disintegration from below, a strong one; it will not hold material together when subject to disintegration from frost and thaw, for it certainly will not hold a road together in any part which mere surface treatment does not reach.

But a road composed throughout of thoroughly tarred material will do all that it has here been stated surface treatment only will not do.

Tar macadam has been in use for many years in England; often it has been a success where least expected, and more often it has been a failure (and when a failure has to be faced it is by far the best plan to go to the root of the trouble and endeavor to ascertain its cause, rather than attempt to continue the failure on the chance of success later).

The failure of tar macadam has been due to the inability to secure the adherence of the tar to the material that was to be tarred. The slightest moisture on the material or chilling of the tar means failure of adherence, and the use of a soft material that would allow of adherence means a failure through the road giving way as a whole.

No material can be used for the manufacture of tar-macadam that is not hot or heated, and the more the material is heated so as to allow the centre of the material to be the hottest part, the better will be the tarring, but the weaker the material.

The materials that have previously proved the most satisfactory in tar macadam work have been limestones from varying neighborhoods, but if limestone has been subjected to a temperature sufficient to heat the stone throughout, the very nature will have been burnt or dried out of the stone, and the fact that tar is afterwards applied will not secure a road material that will stand anything but foot-passenger traffic for any length of time. The difficulty also arises that to heat sufficiently a large quantity of material, a drying and store place of such dimensions is necessitated as to make the cost almost prohibitive, apart from the large amount of manual labor required in so many times handling the material.

In the neighborhood of large iron works slag has been successfully used as a road material, and when it was possible to convert that slag into tar macadam a fair result has been obtained.

Those who know anything of iron as made in England know of the large heaps of refuse which surround the big blast furnaces, and also know the disposal of the slag has long been a source of anxiety to the iron work owners.

While watching the slag pouring out of a furnace one day, it struck the author that the whole trouble of heating the slag for the manufacture of tar macadam was unnecessary, for here was the material that later would be in an ideal condition ready, and of such a nature that the very best results in road construction could be obtained.

He had a breaking and tar mixing plant constructed. The hot slag was brought from the furnaces in large cal-

* Paper read at First American Congress of Road Builders, Seattle, Wash., slightly abbreviated.

drons, each containing about four tons, and allowed to stand for about twenty-four hours until consolidated. It was then tipped onto a cooling ground, and about twelve hours later, when the outside temperature of the slag was about 160° F., broken up either by hand or by means of a dumping hammer, and conveyed, while the outside was still warm, to the breaker. It was then passed through breakers and screened to form varying gauges.

The centre portion of the material, which was still the hottest, was passed into a steam-heated cylinder constructed to keep the material in motion, heated tar, pitch, and other compounds being poured into the same cylinder so as to form a perfect bath, and the whole turned and churned up. From the cylinder it was deposited into the railway trucks and was ready for use.

The material is delivered onto the roads in the county can be produced at the works in a most remunerative manner for eight shillings and six pence, or say, two dollars per ton, to which, of course, must be added railway freights when conveyed to a distance.

The material is delivered onto the roads in the country of Nottinghamshire, with a railway journey of thirty miles, and up to three miles of road cartage, allowing for a thickness of three inches when consolidated, of road crust, at a cost of from 60 to 70 cents per yard super.

This material has been in use for seven winters on a road with a waterlogged, roundstone foundation, that previously had to be coated with 2½ inches of Leicestershire syenite each year, and is now in good and perfect condition with practically no surface dust—and absolutely no dust, as previously was the case, from attrition and disintegration.

The scavenging is reduced to the removal of horse droppings and earth brought from the adjoining fields.

This material has been registered under the name of "tarmac," to keep it from being confused with the old-fashioned tar macadam, and it is different from the latter inasmuch as in its use, the road surface is composed of a good wearing material 1½ inches in gauge, with a minimum of tar to waterproof it and form its proper adherence, instead of, as previously was the case in tar macadam, being composed of very fine particles of softer stone, with a large amount of tar only partially adhering to it.

To construct a good tarmac road it is necessary to have an ordinary road as a bottom, or as good a foundation as is possible; if a waterproof one is desired, then it must be of tarmac. The bottom layer of tarmac can be of four-inch gauge material laid securely and rolled with the interstices filled up with finer tarmac and the whole steam rolled. The next layer should be about ¾ of an inch in thickness of ⅜-inch tarmac and left unrolled; on this should be supplied a 2¼-inch gauge tarmac, rolled into the ⅜-inch, and when rolled, ⅜-inch tarmac should be swept with a brush into every crevice or open joint. Then a further layer of ⅜-inch tarmac should be applied as before, unrolled, and, as a last coating, a perfect layer of 1½-inch tarmac should be applied, and after the roller has passed twice each way over its face, ⅜-inch tarmac should again be swept into each crevice so that a perfect face is presented. The whole must again be steam rolled by a steam roller being passed over three or four times, and the road is at once fit for traffic.

If the traffic will not allow of the whole width of the road surface being stopped at one time, the work can be carried on by taking half the width at a time, but care must be shown in leaving each layer of material to form a Greek key lap.

It is bad work to attempt to feather the edges or thin down a tarmac road. When a patch is applied or a coating ended, it should be finished with a square or butt joint; if otherwise dealt with, the edges will fray or waste away.

The camber, or cross fall, of a tarmac road should not be greater than 1 in 50 from the centre to the sides and a perfect formation should be carried throughout from the foundation so that the whole thickness should be complete.

There is no need for pitched gutter courses in tarmac roads, but in lieu a final washing of boiling tar to a width of 18 inches or 2 feet from the curbing to form a gutter prevents scouring and assists sweeping up in cities and populous places.

In the maintenance of ordinary macadam roads great difficulty is experienced in patching holes and depressions.

A most satisfactory patch can be carried out by means of tarmac; and the practice is followed on all the main roads of Nottingham, either for ordinary wear in water-bound roads or to repair disturbances in tarmac roads.

It is necessary to cut out to the required depth any portion of the road surface that is loose, worn, thin or disturbed, so as to leave a sharp cleanly defined edge. This must be swept clean from any sign of dust in dry weather, then a thin coat of ⅝-inch tarmac should be applied with the greatest thickness at the edges. The necessary material for the patch filling is then applied, well and carefully rammed with a hand rammer, and when rammed any interstices filled with ⅝-inch tarmac, rammed again, and when nearly dry the whole should be swept over with dust from the adjoining road surface. A perfectly level neat patch is thus formed.

A length of tarmac road adjoining a level crossing immediately outside the town of Newark, Notts, and adjoining the Midland railway station, previous to treatment with tarmac in 1898, was annually repaired by the use of 2¼-inch gauge water-bound Leicestershire syenite, the best available road stone of the neighborhood. When first laid the tarmac cost two shillings four pence per yard super. This portion has once been refaced by the application of a 1¼-inch coat of tarmac, in 1905, and to-day is in perfect condition.

A main road a mile and a half outside the city of Nottingham (population 300,000) is greatly used by farm carts, motors and motor lorries, as well as ordinary vehicular traffic of all kinds. It has been laid four winters and has had no other material applied to it. It is practically free from dust and is absolutely an ideal road for all types of self-propelled and other traffic.

## RETAINING AND REVETMENT WALLS.*

**Richard M. Garrett.****

The revetment put in by the Missouri, Kansas & Texas Railway, along the Missouri River for shore protection is built similar to those along the Missouri River, which have been made by the Missouri River Commission, and averages about 60 feet in width. The first work put in by this company was during 1897, and extends from the east city limits of St. Charles down the river for 9,000 feet. A rock dike was first built out into the river, and a boom made of heavy timbers was anchored to lower side of dike, and laid parallel with it. From this boom the mat was started, having its full width at the beginning. The mat was first woven and sunk, and then the bank was graded by hydraulics to a slope of 2 to 1, and then paved from the top down.

In 1903, work was extended 3,000 feet down the river, and was done in the same way as the first section, with the exception that the mat was anchored at the starting point with piles instead of the boom.

In 1906, revetment was again extended 7,200 feet. On this last section the bank was graded to a slope of 2½ to 1 in advance of weaving the mat, as considerable trouble had been experienced on former works, on account of material from the bank covering the mat, so that a connection between paving and mat could not be properly made.

Grading on this section was done with a small hoisting engine on a barge, as follows:—A derrick was erected on barge, having a boom long enough to reach the top of the

*Abstract from Bulletin No. 108 of the American Railway Engineering and Maintenance of Way Association.

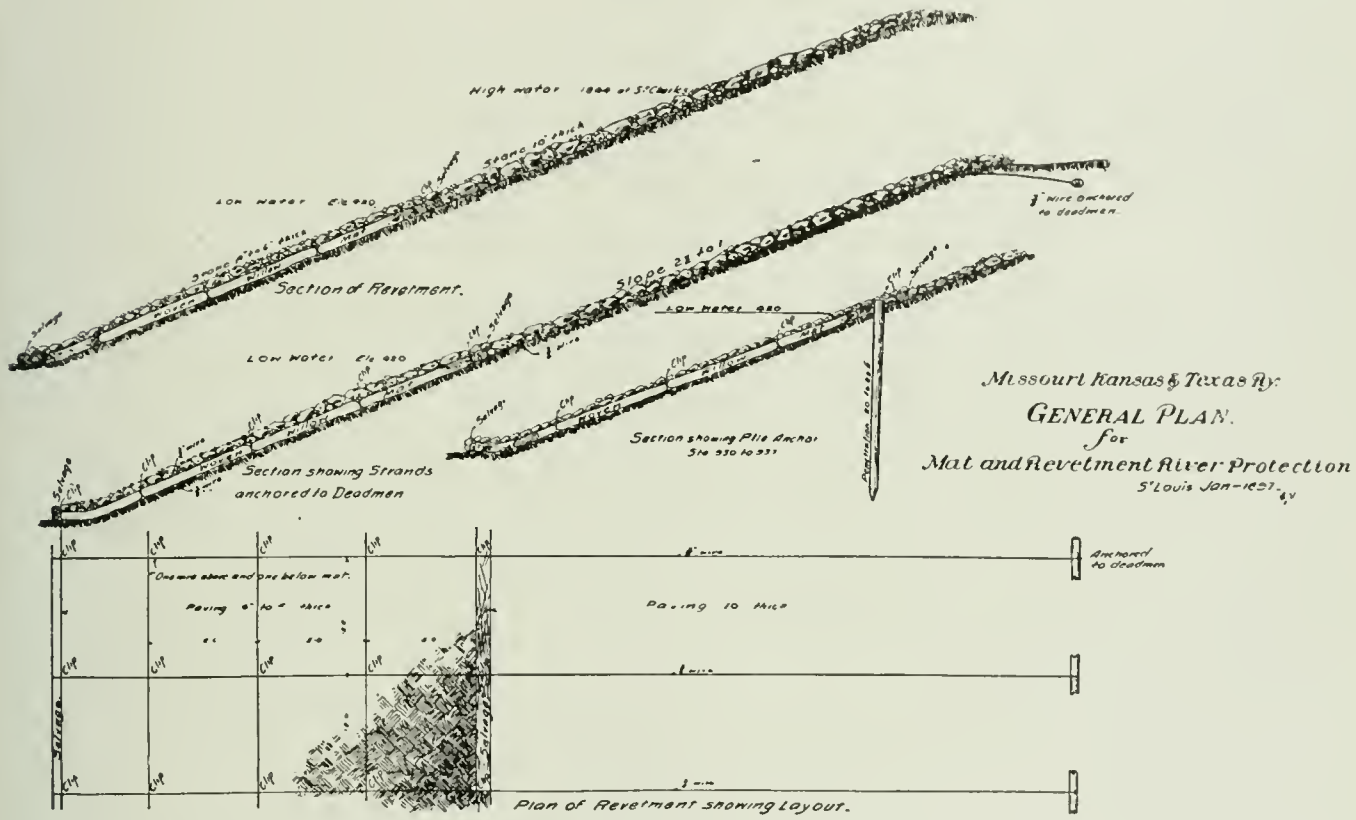
**Resident Engineer, Missouri, Kansas, and Texas Railway.

bank to be graded, a No. 3 wheeler scraper pan was pulled along this boom from the barge to the top of bank, by a mule on the bank, and was held in place by two men and filled, and then dragged down the bank by the hoisting engine. The beginning of mat was anchored to deadmen on top of bank about 200 feet up stream, and weaving was begun about 100 feet back on the old mat, so that full width of new mat was gotten where the unprotected bank commenced.

In 1908, 4,000 feet of revetment was put in on north side of river just above Boonville Bridge. At Kingsbury, there is a siding on the west side of main line, and out of the south end of this track the spur was built to the river; this required a main track of 6,500 feet in length, and a spur track 900 feet in length. Track was laid about 5 to 20 feet from top of bank all along where revetment was to go in, so that rock could be unloaded and used with as little handling as possible. The bank was first graded to a slope of $2\frac{1}{2}$ to 1 by teams; the mat was then woven and sunk, and the slope paved from bottom up. It is the description of this last section that will be given, as the only differences between this and other works are those mentioned.

as the natural surface. Grading was never carried further than 200 feet in advance of weaving, as the barges from which the mat was being woven would protect the bank from the current for this distance.

The mat was woven 60 feet wide with a selvage edge on out-stream side, and sunk parallel with shore with the inner edge about 3 feet above the average low water. The mat was strengthened with five double rows of $\frac{3}{8}$-in. galvanized steel cable (7 strands No. 11 wire) laid longitudinally one above and one below, and anchored with a double row of similar cable laid transversely every 15 feet and fastened to deadmen, buried 3 feet deep and located 15 feet back from the upper edge of slope. At every intersection of the longitudinal with the transverse rows, the four cables are fastened together with a $\frac{5}{8}$-in. "U" clip. The transverse rows are fastened to deadmen by wrapping one cable around the deadmen twice and then fastening it to the other cable with two $\frac{3}{8}$-in. "U" clips. The deadmen are pile butts about 3 feet long, and the object in fastening the cable to them, as mentioned, is to allow the cables to slip when loaded, so that the same strain will be on both the under and upper cables.




The bank was about 18 feet higher than what was taken as the average low water; the soil is mostly a very fine sand and very little gumbo; the bank was clear of timber and brush, but there were several large snags along where mat was to lie that were taken out by sawing, blowing-out and using teams and line.

Shovelers first dug along the top of the bank and shoveled down all the perpendicular and overhanging points, so as to make it safe for a mule to walk along close to the edge; then a two-mule team plowed two or three furrows as close to the edge of the bank as team could be gotten. The mules were then hitched to a "Go-Devil," constructed of two 2 x 10-in. plank 8 feet long, fastened together at the front end and flared to about 4 feet at the back end; it required one man to drive the mules and one man to weight the drag. This was then run along the back side of furrows, and the loose earth shoved toward the river. After the bank began to slope, two or three slips were put on, and the bank brought to the desired slope.

It will be seen that only about half of the material in slope is moved, as the excavation makes the fill and does not wash away, as it does when grading by hydraulics. It was found that with this material the filled portion was as solid

The willows were cut from bank of river about one mile above mat, and were hauled by wagons, hauling about 1.6 cords to the load. The road was bad at times, and it required a snap team to pull out of the mudholes, but most of the time the road was in good shape. It required 0.6 cord of brush to 100 sq. ft. of mat; average thickness of mat, about 18 in.

Weaving was started at a point at upper end and gradually widened out to full width, anchors being placed for longitudinal cables in top of bank about 100 feet above upper end. The mat was woven with four small barges fastened together, so as to make the desired width. Fingers of skids were built on barges out of 3 x 12-in. plank, 24 feet long, and spaced 5 feet apart, extending from the water level on up-stream side to an elevation of 3 feet above floor of barge at a point about 3 feet back from down-stream side. Spools of cable were set under the down-stream ends of fingers at the proper position for the under longitudinal cables, so that cable would unwind as the barge was let down stream. Barge was anchored at the shore end to the track, and at the upper end to the mat that had been woven. Mat was woven on the barge as high as the fingers would permit, and cable and clip men would pull the under cables through the mat by means of an iron hook about 2 feet long.

and the top longitudinal cables were run under these, and all were fastened together with a 5/8-in. clamp. Barge was then pulled from under the mat with a team, and anchor ropes slacked just enough so that about 3 feet of mat would be left on fingers. Top longitudinal cables were cut off the reel on shore in lengths of about 100 feet, and spliced together with a square knot on mat, as the work proceeded.

Mat was sunk and held down with stone weighing from 30 to 50 lbs. An average of 1.5 cu. yards of stone being used to the 100 sq. ft. of mat. Rock for sinking was unloaded from cars onto shoulder of slope and wheeled in wheelbarrows out onto the barge, anchored lengthwise across the mat, and dumped along the edge of barge. Mat was sunk from shore side out, so that it would settle away from shore and the transverse cables would tighten up. Sinking was kept at least 100 feet back from weaving barge to prevent pulling the mat off the barge. When the water was higher than the proper elevation for the shore side of mat, it was sparred out, so that in sinking it would settle to its proper position.

The rock for paving slope was unloaded from cars onto slope and rolled down to the bottom, where paving was begun. Paving is 10-in. thick, and was paved from the bottom up, care being taken to fill all the cracks with small stone. At the upper edge of paving, spawls were piled so as to keep the surface water from washing under the paving and starting it to roll. As long as the water was low, a good connection was gotten between paving and mat, and there were parts of this work that were paved during high water, and the rock slid in afterward, making repairs necessary. The work done on the first section in 1897 is in very good shape to-day. The mat has rotted where it has been exposed to the air, but the paving is in good condition.

There have been some slides on the work done in 1906. At these places it was found that the rock was settling under the edge of mat. These were places where the bank had washed after mat had been put in, and the mat does not lie up on the bank as it should.

Considerable trouble has been experienced on account of the eddy caused by the end of the revetment. At Boonville Bridge, the revetment ends at an old rock dike, and no difficulty is expected at that point; but at all of the other places it has given trouble. At the end of the work done in 1906 it is probably more noticeable. The revetment at this place was ended at a place where the bank extended out into the river 400 or 500 feet, and now the bank is 100 feet further in than the revetment, and the revetment has been repaired twice on account of the river washing behind the end, and allowing the rock to fall in.

The cost of the Boonville Revetment is as follows:—Cost per lin. ft. for 60-ft. mat; banks 18 feet above low water; laborers paid $1.50 per day; foremen $4, and teams, $3.50. This does not include interest on investment or make allowances for rainy days and moving, but is the actual cost. The contractors' profit is included in the track work only:—

| | | | c. |
|---|---|---|---|
| Grading bank per lin. ft. | | | .13 |
| Weaving mat | | | .410 |
| Sinking mat | | | .110 |
| Paving slope | | | .230 |
| Willows, including cutting, hauling and unloading, and price paid landowner | | | .340 |
| Rock, at 0.75, delivered on site (2.3 cu. yds. to the lin. ft.) | | | 1.730 |
| Unloading rock | | | .120 |
| Spotting cars with teams | | | .004 |
| Hauling deadmen and cable | | | .018 |
| Taking out snags | | | .030 |
| Cable and Clips: | | | |
| 1260 — 5/8-in. clips @ .06 | 75.60 | | |
| 746 — 3/4-in. clips @ .035 | 26.16 | | |
| 1.715 — 3/4-in. cable @ 1.00 | 1071.50 | 1173.26 | .300 |
| Deadmen, 270 @ 50 = $135.00 | | | .035 |
| Track, 7,500 lin. ft. | | | |
| Labor, grading, including contractors' profit. | | | |
| Labor laying | | $1493.20 | |
| Taking up | | 1000.00 | |
| | | 4075.10 | |
| Bridge across draw | | 460.00 | |
| | | 4535.10 | 1.140 |
| Grading spur to quarry, $393.50 | | | .074 |
| Total cost per lin. ft. | | | $4.67 |

W. S. Kinnear (Assistant General Manager, Michigan Central Railroad), in a written discussion on slides adds the following:—The writer has had quite a little experience with embankment slides, under various conditions, and recalls a sidehill embankment which gave us endless trouble from the first heavy rainfall after its construction until slide was finally checked, which will be explained hereafter. As mentioned, the embankment was on a sidehill, and initial steps to remedy the trouble consisted in hauling material by train and filling as rapidly as bank would go out below. It was found after a short time this would be practically an endless performance, and measures were taken to ascertain the cause of the slide. A careful examination of the slope on the upper side disclosed a sloping waterbearing strata of clay, some 8 or 10 feet below the actual surface of the side-hill. For a considerable time after each heavy rainfall the top of this waterbearing clay would be thoroughly saturated, and it was found, in case of any disturbance below, the weight of the embankment would produce immediate slipping or sliding on the smooth clay. It was thought best to intercept the water from above and let the surface of clay, carrying the embankment below, dry out. This was done by means of a sheet piling ditch, about 3 feet wide, some 15 or 20 feet above the embankment. The sheet piling was driven a sufficient distance in the clay to secure firm footing and to prevent distortion. The material overlying the clay was excavated within the limits of the sheet piling, thus forming a ditch, which was carried to a waterway through the embankment to an outlet below. No further trouble was experienced, and the embankment held. It might be mentioned in this connection that a short time prior to the construction of the sheet piling ditch on the upper side one or two rows of piles were driven near the lower slope of the embankment, hoping in this manner to form some resistance to further slipping. The piles did absolutely no good, and were carried down and out of position by the slipping bank in a very short time. The writer thinks it is of the utmost importance, in case of either embankment or excavation slides, to immediately ascertain the cause, and thus save a great many false moves, which, at best, are very expensive.

The writer has also had trouble a great many times from old embankments, and has in mind one or two cases where high banks some 20 or 30 years old gave considerable trouble after periods of ordinary rainfall, due to conditions which we could not discover. We found the best treatment under such circumstances was to build perpendicular blind drains down the slopes, connecting with a similar blind drain parallel to the foot of the embankment. These drains were placed from 50 to 100 feet apart, as conditions seemed to demand, and consisted of an excavated trench some 3 or 4 feet deep, filled with one-man stones. These were carried entirely down the slope and brought up against a similar trench filled with stone carried along the foot of the slope throughout the length of the slide. We have not found one single instance where his method was not effective in stopping trouble.

It has been the writer's experience that slides in old embankments were likely to occur after the construction of a second track roadbed. This was undoubtedly due to an interpretation of the drainage and pressure of the new bank upon the old. Our method of treatment in such cases was similar to that described immediately above.

The writer has found from experience that landslides are very difficult to contend with, and in the majority of cases about the only remedy which can be applied is to keep the track as near grade as possible and wait for a new and per-

manent condition of the slope to become established. A study of the possibility of diverting certain surface water is always advisable under such conditions, and, in some cases, may prove of benefit, although we have always found, where a mountain side or steep sidehill is disturbed by the construction of a line of railroad, trouble will undoubtedly be experienced, which it will take years to overcome. The writer is not a believer in driving piles either in embankments or excavation to hold sliding masses.

## INTERNATIONAL CONFERENCE OF ELECTRICAL UNITS AND STANDARDS, 1908.

The "blue-book" report of the International Conference on Electrical Units and Standards, held in London, England, in October 1908, has just been distributed—eleven months after the conference closed.

The resolutions are of considerable interest, and we give them in full. Two of the specifications prepared are also re-published, as they may be taken to represent the most recent decisions on these matters.

### Schedule B.—Resolutions.

The conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electro-magnetic system of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass and the seconds as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0.1) in terms of the centimetre, gramme, and second; (3) the volt, unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme, and the second; (4) the watt, the unit of power which has the value 10,000,000 in terms of the centimetre, the gramme, and the second.

2. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions:

3. The ohm is the first primary unit.

4. The international ohm is defined as the resistance of a specified column of mercury.

5. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.5421 grammes in mass, of a constant cross sectional area and of a length of 106.300 centimetres.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in Specification I. attached to these resolutions.

6. The ampere is the second primary unit.

7. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the Specification II. attached to these resolutions, deposits silver at the rate of 0.00111800 of a gramme per second.

8. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

9. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electrical pressure of one international volt.

### Specification I.—Specification Relating to Mercury Standards of Resistance.

The glass tubes used for mercury standards of resistance must be made of glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimetre. The mercury must have a resistance of approximately one ohm.

Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed 5 parts in 10,000.

The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube.

The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0°C as possible. The measurements are to be corrected to 0°C.

For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimetres) and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass.

The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula.

$$A = \frac{0.80}{1063\pi}\left(\frac{1}{r_1} + \frac{1}{r_2}\right) \text{ ohm.}$$

where $r_1$ and $r_2$ are the radii in millimetres of the end sections of the bore of the tube.

The mean of the calculated resistance of at least five tubes shall be taken to determine the value of the unit of resistance.

For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

### Specification II.—Specification Relating to the Deposition of Silver.

The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that no more than 30 per cent. of the silver in the solution is deposited.

The anode shall be of silver, and the kathode of platinum. The current density at the anode shall not exceed one-fifth ampere per square centimetre and at the kathode 1-50 ampere per square centimetre.

Not less than 100 cubic centimetres of electrolyte shall be used in a voltmeter.

Care must be taken that no particles which may become mechanically detached from the anode shall reach the kathode.

Before weighing, any traces of solution adhering to the kathode must be removed, and the kathode dried.

### Schedule C.—Weston Normal Cell.

The Weston Normal Cell may be conveniently employed as a standard of electric pressure for the measurement both of E.M.F. and of current, and when set up in accordance with the following specification may be taken, provisionally,

(Continued on Page 360).

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

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UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING — CONTRACTORS.—President, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

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CANADIAN FORESTRY ASSOCIATION. — President, Thomas Southworth; Secretary-Treasurer, King Radiator Co., Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

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ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H Warder, Secretary.

## COMING MEETINGS.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# ASTRONOMICAL PAGE

Star Map for October 1st, 1909, 10 p.m.

CUT HERE FOR REFERENCE.

## STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., OCTOBER 1st, IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for October 15th at transit across the meridian of 5h W. of Greenwich.

| Star | Mag. | R. A. h. m. s. | Decl. ° ′ ″ |
|---|---|---|---|
| α Andromedæ | 2.1 | 0 03 43.5 | + 28 35 36 |
| β Cassiop. | 2.4 | 0 04 22.3 | + 58 39 12 |
| α Cassiop. | 2.5 | 0 35 23.5 | + 56 02 36 |
| γ Cassiop. | 2.3 | 0 51 16.2 | + 60 13 43 |
| α Ursæ Min. (Polaris) | 2.1 | 1 27 31.5 | + 88 49 26 |
| α Arietis | 2.2 | 2 02 05.2 | + 23 02 13 |
| α Tauri (Aldebaran) | 1.1 | 4 30 44.3 | + 16 19 47 |
| α Aurigæ (Capella) | 0.2 | 5 10 00.9 | + 45 54 22 |
| β Ursæ Maj. | 2.4 | 10 56 21.7 | + 56 52 00 |
| α Ursæ Maj. | 2.0 | 10 58 07.3 | + 62 14 16 |
| γ Ursæ Maj. | 2.5 | 11 49 02 8 | + 54 11 49 |
| δ Ursæ Maj. | 3.4 | 12 10 55.3 | + 57 32 07 |
| ε Ursæ Maj. | 1.8 | 12 50 01.1 | + 56 27 04 |
| ζ Ursæ Maj. | 2.1 | 13 20 15.1 | + 55 23 05 |
| η Ursæ Maj. | 1.9 | 13 43 56.8 | + 49 45 58 |
| α Lyræ (Vega) | 0.1 | 18 33 51.9 | + 38 42 10 |
| α Aquilæ (Altair) | 0.9 | 19 46 22.0 | + 8 37 50 |
| α Cygni | 1.3 | 20 38 21.0 | + 44 57 38 |
| β Pegasi | 2.4 | 22 59 24.0 | + 27 35 40 |
| α Pegasi | 2.6 | 23 00 15 9 | + 14 43 14 |

### Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on October 1st, 1909, for places in longitude 5th ( = 75° W.) and at certain standard times T:

| T P.M. h. m. | Sid. Time h. m. s. | Lat. = 44 ° A | ′ a | Lat. = 48 ° A | ′ a | Lat. = 52 ° A | ′ a |
|---|---|---|---|---|---|---|---|
| 8 00 | 20 40 26 6 | 1 33 46 | — 8 | 1 40 53 | — 9 | 1 49 45 | — 9 |
| 8 30 | 21 10 31.5 | 1 29 07 | —11 | 1 35 56 | —12 | 1 44 25 | —13 |
| 9 00 | 21 40 36.4 | 1 22 55 | —14 | 1 29 17 | —15 | 1 37 13 | —16 |
| 9 30 | 22 10 41.4 | 1 15 14 | —17 | 1 21 02 | —18 | 1 28 10 | —20 |
| 10 00 | 22 40 46.3 | 1 06 13 | —19 | 1 11 20 | —21 | 1 17 44 | —22 |
| 10 30 | 23 10 51.2 | 0 56 00 | —21 | 1 00 21 | —23 | 1 05 47 | —25 |
| 11 00 | 23 40 56.2 | 0 44 47 | —23 | 0 48 16 | —25 | 0 52 37 | —27 |
| 11 30 | 0 11 01.1 | 0 32 45 | —24 | 0 35 18 | —26 | 0 38 30 | —28 |
| 12 00 | 0 41 06.0 | 0 20 07 | —25 | 0 21 42 | —27 | 0 23 40 | —29 |

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.
T = the time for October 1st.
L = the longitude.
d = number of days elapsed since October 1st.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° ( = 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on October 8th.

Here the interpolated value of the azimuth for 8h 30m is 1° 38′ 34″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 ( = 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

### Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) - (L - 5h)$.

Where

S = the required sid. time.

S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\alpha - S)\ (1 - 0s.16)$.

Where

T = the required standard time of transit of the star, and

T′ = the tabular time corresponding to S′.

$\alpha$ = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star α Pegasi is observed at the watch time 10h. 12m. 14.5 sec. at the same place and date as above; to find its correction on standard time.

| | | h. | m. | s. |
|---|---|---|---|---|
| Sidereal time, 10h. 00m. (table) .. | = | 22 | 40 | 46.3 |
| 7 × (3m 56s. 555) ..... | = | | 27 | 35.9 |
| | | 23 | 08 | 22.2 |
| Difference of longitude ..... | = | | 20 | 00 |
| S ..... | = | 22 | 48 | 22.2 |
| R.A. of star ..... | = | 23 | 00 | 15.9 |
| α — S ..... | = | | 11 | 53.7 |
| 11.9 × 0s.16 ..... | = | | | 1.9 |
| Equivalent mean time interval .... | = | | 11 | 51.8 |
| T′ ..... | = | 10 | 00 | 00 |
| T ..... | = | 10 | 11 | 51.8 |
| Watch ..... | = | 10 | 12 | 14.5 |
| Watch fast ..... | = | | | 22.7 |

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

In a paper on steam turbines read before the Incorporated Municipal Association, at Manchester, by Alfred S. Blackman, borough electrical engineer and manager at Sunderland, the author estimated that the maintenance of a steam turbine plant, consisting of turbine, alternator and condensing plant, should not exceed $500 per year per 10,000,000 generated, and in many cases would be less than this.. He quoted some figures on the consumption of his 2000-kw turbine, as follows: Steam with 27½-in. vacuum, 17.07 lb. per kw-hour on one test and 17.1 lb. on another. The cost of oil per turbine, generating 9,000,000 kw-hours during the year, was $64, and for the auxiliaries $88.12 for the year.

## INTERNATIONAL CONFERENCE.

(Continued from Page 357).

as having, at a temperature of 20°C., an E.M.F. of 1.0184 volts.

### Specification Relating to the Weston Normal Cell.

The Weston Normal Cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4$ 8-3 $H_2O$) as its electrolyte.

The electrolyte must be neutral to Congo Red.

The positive electrode of the cell is mercury.

The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by weight of cadmium in 100 parts of amalgam.

The depolarizer, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate.

The different methods of preparing the mercurous sulphate paste are described in the notes. One of the methods there specified must be carried out.

For setting up the cell, the H form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other.

The depolarizer is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed.

The following formula is recommended for the E.M.F. of the cell in terms of the temperature between the limits 0°C and 40°C.

$E_t = E_{20} - 0.0000406\ (t - 20°) - 0.00000095\ (t - 20°)^2 + 0.00000001\ (t - 20)^3$.

## THE DISINTEGRATION OF CEMENT IN SEAWATER.

At the Seventh International Congress for Applied Chemistry in London, England, H. L. Chatlier, read a paper on the title subject of this article.

In this lecture he set forth the following conclusions: All hydraulic cements are without exception disintegrate when immersed in seawater, but considerable difference in rapidity of disintegration exists. This disintegration will be slower:

(1) The smaller the percentage of aluminum, a comparatively small amount of aluminum, in fact, 2% is sufficient to bring forth all disadvantages of the cement.

(2) The greater the coefficient, at least with the common Portland cements. Of course it is a fact that under the usual conditions an increase of the coefficient will bring about a crumbling to powder cooling off, which influences the mechanical resistance in an undesirable quick time.

(3) The quick setting cements containing a high percentage of calcium sulphate and high coefficient can produce very satisfactory results. The reduction of the resistance with a simultaneous increase of the coefficient is less than is experienced with Portland cements, because the existence of calcium-sulphate, as found by Candlat, will tend to counteract the crumbling of cement when cooling off.

(4) An addition of Puzzolan, especially of burned clay and doubtless a good quality of trass will aid all hydraulic products to a high degree of chemical resistance.

Through binding of the calcium in insoluble combinations an edulcoration will be counteracted, as well as an increased porosity of the mortar.

(5) The density of the mortar which has been known a long time is still the chief factor for the conservation of mortar in seawater. In this respect the addition of puzzolan regardless of any direct chemical action, adds considerably to obtain a more dense concrete. This at least is the conviction of the author from extensive experiments.

In a discussion on the above Feret stated that in some details the above does not correspond with experiments conducted by him.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

COMO.—Tenders will be received up to Thursday, September 30th for macadamizing eight miles of road. A. W. Mullan, Secretary-treasurer, Hudson Heights, Que.

MONTREAL.—Tenders will be received up to Wednesday, the 29th September, for the supplying and installing of a complete Heating Plant in the Corporation Shops on Grand Trunk street. L. O. David, City Clerk.

QUEBEC.—Tenders will be received until Thursday, October 7, for the construction of a dam on Kipawa River, County of Pontiac. Plans may be seen at the offices of J. G. Sing, resident engineer, Toronto; J. L. Michaud, Merchants Bank Building, St. James Street, Montreal, and at the Department of Public Works, Ottawa. Napoleon Tessier, secretary.

**Ontario.**

BARRIE.—Tenders for the construction of the sewage outfall works in connection with the Allandale sewers, now under construction, were opened this week, but in the judgement of the committee and engineer were not acceptable; the town is advertising again in these columns calling for tenders to be in on September 30th, 1909. C. H. & P. H. Mitchell, consulting engineers, Toronto.

CORNWALL.—Tenders for extension of wall above Lock 18, Cornwall Canal, will be received until Monday, October 4th. Plans can be seen at the Department of Railways and Canals, Ottawa, and at the office of C. D. Sargent, Resident Engineer, Ontario, St. Lawrence Canals, Cornwall, Ont.

GUELPH.—Tenders will be shortly invited by the Radial Railway Board for a new steel bridge over the river Speed at Dundas Road. Plans are in course of preparation for a structure to cost from two to three thousand dollars.

OTTAWA.—Tenders for Postoffice Boxes and Drawers will be received until Friday, October 1st. By order, Napoleon Tessier, Secretary, Department of Public Works.

RAINY RIVER.—Tenders will be received until Saturday, September 25, for the erection of a frame fire hall and council chamber on concrete foundation. Specifications may be seen at the office of the town clerk, Rainy River, or at Pratt & Ross, Architects, Winnipeg.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders are invited until 5th October by the City of Toronto for 16-inch cast iron pipe and valves. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in Canadian Engineer).

TORONTO.—Tenders will be received until Monday, October 4th for the erection of a reinforced concrete bridge over the river Don at Wilton Avenue. Joseph Oliver, (Mayor) Chairman, Board of Control. (Advertised in The Canadian Engineer.)

**Manitoba.**

PORTAGE LA PRAIRIE.—Tenders will be received until Thursday, September 30th, for the construction of a needle dam. Smith, Kerry & Chace, Consulting Engineers, Library Building, Winnipeg.

WINNIPEG.—Tenders for supply of cast iron water pipe of the following quantities and sizes, delivered f.o.b. cars, Winnipeg, namely, 20,000 feet of 8-in. pipe, 6,000 feet of 10-in. pipe, 6,000 feet of 18-in. pipe, will be received up to September 29. M. Peterson, Secretary Board of Control.

WINNIPEG.—Tenders will be received up to Monday, November 1, for supply of one motor hose wagon for the Fire Department capable of carrying 2,000 feet of 2½-in. cotton, rubber lined, fire hose, approximate weight, 2,200 lbs., and six men, approximate weight, 1,020 lbs. M. Peterson, Secretary Board of Control.

**Saskatchewan.**

SASKATOON.—The time for receiving tenders for the construction of a subway under the C.N.R. tracks has been extended to Wednesday, October 6th. J. H. Trusdale, City Clerk. (Advertisement in the Canadian Engineer.)

YORKTON.—Tenders will be received until Tuesday, September 28th, for cast iron pipe and laying of mains. F. T. McArthur, B. Sc., Town Engineer. (Advertised in the Canadian Engineer).

**British Columbia.**

VANCOUVER.—Tenders will be received until September 27th for the erection of five sub-stations for power distribution on the New Westminster-Chilliwack line of the British Columbia Electric Railway.

VICTORIA.—Tenders will be received until Monday, October 11th, for 2,500 feet of 12-inch pipe; 15,000 feet of 8-inch; 20,000 feet of 6-inch and must be delivered in 30-feet lengths, covered with jute and double coated, inside and out, with asphalt solution. Delivery must be made by March 15th next. W. W. Northcott, purchasing agent.

## CONTRACTS AWARDED.

**Nova Scotia.**

HALIFAX.—At a recent meeting of the Works Board, tenders for supplying 20,000 brick were opened. Black and Flinn tendered at $8.60 per thousand, General Contractors Supply Co., $7.65 and J. Simmonds & Co., $7.25. The latter being the lowest was accepted.

**Quebec.**

MONTREAL.—The contract for concreting the Lafontaine Park pond has been given to the Artificial Marble Company of this city. Contract price, $3,650.

**Ontario.**

ORILLIA.—Sewer construction tenders were awarded on Tuesday, September 14, as follows:—Laying fifteen thousand feet of sewers, and providing tile pipe therefor, Jas. A. McIlwraith, of Collingwood, $11,815. Mr. McIlwraith was also awarded contract for laying the iron pipe for sewer force main, at $3,825. Supplying 7,000 feet of iron pipe, Canada Foundry Co., at $31.95 per ton, a total of $3,205. Building the pumping station, Timothy Clement, $6,175. Machinery for this building will be furnished by the John McDougall Caledonian Iron Works, of Montreal, at $4,166. Mr. Willis Chipman, consulting engineer, of Toronto, has charge of the work.

GUELPH.—The contract for laying Westrumite on Paisley Street was let to the Westrumite Company at $5,232.40.

PETERBORO.—Messrs. E. & F. Conroy, of Peterboro, will build the new reinforced concrete bridge on Smith St., for $28,457, which is $1,700 higher than the tender of Geo. A. Begy & Co., of St. Catharines, Ont., who were originally given the contract.

**Manitoba.**

WINNIPEG.—The contract for the construction of a pipe line from the Red river to the National Transcontinental

railway shops at St. Boniface has been awarded to the Western Construction company of Winnipeg, the lowest tenderers. The contract price is 34½ cents per yard.

WINNIPEG.—The Board of Control have accepted the tenders of the Western Coal Company, for screenings at $7.25 a ton.

**British Columbia**

VICTORIA.—Mr. H. W. Kent of the British Welding company and the Jens Orten-Boving Company of London, has been awarded the contract for 55,000 feet of 30-inch welded steel pipe for the Esquimalt Waterworks company. The pipe is to be laid from the company's plant at Goldstream to the city limits at Victoria. These old country firms are famous manufacturers and the pipe which is to be supplied to the Esquimalt Waterworks company is manufactured at Motherwell, Scotland. The first consignment will be sent on the Holt steamship line and is to arrive next March.

VICTORIA.—Luny Brothers have been given a contract for the erection of a branch of the Royal Bank on Government Street here. Their price, about $50,000, includes a British Columbia granite front and considerable reinforced concrete work.

## RAILWAYS—STEAM AND ELECTRIC.

**Nova Scotia.**

SYDNEY.—The Cape Breton Electric Company have been asked by the city council to make numerous extensions.

**New Brunswick**

ST. JOHN.—It is expected that the International Railway will be completed this fall. Eight miles of the line are yet under construction.

ST. JOHN.—Mr. C. O. Foss, chief engineer of District A of the Transcontinental, has returned to St. John, from a trip of inspection over the construction work in Victoria County. Mr. Foss examined the Salmon River viaduct, which he says is the largest piece of bridge work on the Transcontinental, and probably the largest of the kind in Canada. The viaduct is built of steel trestle work, with the uprights sunk in concrete pedestals, and crossed by heavy steel girders at the top. In all, the viaduct will be 4,800 feet in length and its completion requires the exercise of very careful engineering skill. The substructure is nearly finished, and work has begun on the superstructure.

**Quebec.**

MONTREAL.—Mr. M. J. O'Brien has accepted the presidency of the Matane and Gaspe Railway. The line begins at St. Flavie Station and runs down the shore of the St. Lawrence to Matane, about forty miles. The work of construction is to be rushed, and it is expected that trains will be running over the line by next August.

**Ontario.**

BARRIE.—Mr. John W. Moyes, of Toronto, has roughly outlined a proposition by which Barrie would have a street railway. He proposed to connect the C.P.R. and C.N.R. at Atherley with the C.P.R. at the thirteenth concession of Essa by an electric line.

BRANTFORD.—The street railway company are asking permission of the council to extend their system. They propose to lay a second track on Brant Avenue.

COBOURG.—The Canadian Northern Railway are rushing the survey of their new line in this vicinity. One party in charge of Mr. Con. O'Gorman, with headquarters at Cobourg, is making a survey from Cobourg east. Another party, with Mr. Armstrong in charge, is surveying between Cobourg and Port Hope.

OTTAWA.—Tenders closed on Thursday with Mr. M. J. Butler, chairman of the Government Railways Managing Board, for construction of a six stall addition to the engine house at Riviere du Loup, Que.

PORT ARTHUR.—Work commenced on Monday on the Arthur Street extension of the street railway, the first of a series of branch lines to serve part of the city not reached by the main line.

STURGEON POINT.—Mr. S. Anderson, who is now operating 40 miles of electric railway is said to be looking into the possibility of a street railway system from Fenelon Falls to Bobcaygeon, passing through Sturgeon Point.

WELLAND.—Mr. B. Corey has applied for a franchise to operate an electric railway on the streets of Welland. It is expected to run from Port Colborne to Niagara Falls. The N., St. C. & T. Railway will at once start extending the line from Welland to Port Colborne, and it is expected to be in running operation this fall. The survey has been completed and a lot of the material ordered.

WINDSOR.—The last section of the subaqueous tunnel connecting Windsor and Detroit was laid on Tuesday morning, September 14th, and it is expected that trains will be running through by the first of the year.

**Manitoba.**

BRANDON.—Sir Thomas Shaughnessy is reported to have said that the double-tracking of the C.P.R. between here and Portage la Prairie would be undertaken in the near future.

WINNIPEG.—Steel laying on the Superior Junction to Winnipeg Section of the G.T.P. is practically completed.

WINNIPEG.—On Wednesday, the 22nd, Mr. Frank Lee, Division Engineer of the C.P.R., received tenders for some grading work near Schwitzer, Man.

**Saskatchewan.**

SASKATOON.—Laying steel on the line of the Canadian Pacific between Saskatoon and Wetaskiwin will be completed next month. Several hundred men have been sent by the Canadian Pacific from Montreal during the past few weeks to assist in this work. Two steel gangs have been working up to the present, but the work is now centred on the west end. Three weeks will complete the laying of steel, after which as much ballasting as possible will be done before the freeze up. This line will constitute the main line of the Canadian Pacific between Winnipeg and Edmonton, and much traffic which now goes by way of Calgary will be delivered to it as soon as it is completed. Trains will be operated over the line this fall.

**Alberta.**

EDMONTON.—The G.T.P. track between Edmonton and Pembina River will be opened for general traffic within two months. The big tracklaying machines on G.T.P. construction west of Edmonton have been removed to Melville, where they are now being used on the branch line north from Melville to Yorkton and the branch south from Melville to Balcarres on the Regina extension. It is expected that both branches will be ready to handle grain within two weeks.

**British Columbia.**

VANCOUVER.—Tenders have been called for the construction of five sub-stations along the line of the British Columbia Electric Railway Company from New Westminster to Chilliwack. The buildings are to be of concrete, and in general similar to those now in operation on the lines of the New Westminster and Lulu Island interurban extensions. They will be used for the distribution of light and power to the surrounding districts as well as in connection with the operation of the tram system.

VANCOUVER.—The Great Northern Railway Company are buying property on the waterfront here. They already have ninety thousand dollars' worth, and if they purchase the entire property at the same price per foot—four hundred dollars—it will require an outlay of nearly a million and a half.

VANCOUVER.—The Eburne branch of the British Columbia Electric Railway which provides a new route between New Westminster and Vancouver, and opens up undeveloped territory along the north arm of the Fraser River, was opened last week.

VANCOUVER.—Officials of the G.T.P. are having trouble with the Indians at Kitsumkalum. The railway company want to build their line through an Indian grave-yard and the Siwashes refuse to accept their terms of compensation. The Dominion Government is inclined to think the

proposition of the company is quite fair and the Indian Department have sent a man out with a view to a settlement being reached.

VICTORIA.—The contract for the mountain section of the Mill Bay Road has been awarded to M. J. Carlin by the Provincial Government. The cost will be $130,000 for the ten miles of road necessary to link up the six-mile and two-mile sections, work upon which has been underway for the past eight months. By the terms of the contract the road is to be completed by January next, and for the first time the upper portion of the island will be in communication with Victoria by a feasible and practicable trunk road. The construction of this section involves heavy rock cuts.

**Foreign.**

DETROIT, MICH.—The Michigan Central will build a new two-million dollar station at Detroit.

## LIGHT, HEAT, AND POWER

**Ontario.**

GALT.—Galt town council recently considered a proposition to buy the local electric lighting plant and referred the matter of an estimate of its value to Mr. E. B. Merrill, C.E., of Toronto. The price asked by the Galt Gas Light Company, which owns the existing plant, is $67,000. This does not include the water power at the dam, an auxiliary property, earning $1,474 a year in rentals, and the value of which is unstated in the offer.

NIAGARA FALLS.—The Commissioners of Queen Victoria (Niagara Falls) Park have given permission for another undertaking by the Ontario Power Company. The company will spend over a million dollars in laying another pipe from the gate-house to the power house. The new pipe is to be the same diameter as the old, eighteen feet, but instead of being steel, encased in concrete, it will be wholly of reinforced concrete.

PETERBORO.—The Otonabee Power Company, who have asked the city for a twenty-year franchise, propose to spend $250,000 in uniting their two dams.

**Manitoba.**

WINNIPEG.—In accordance with the recommendation of Professor Herdt, of McGill University, Montreal, the Winnipeg Street Railway has opened the first of three sub-power stations. It is hoped by these and by bonding the rails, to reduce the danger to water mains and gas pipes from electrolysis.

**British Columbia**

VICTORIA.—The work of installing the $1,500,000 power plant which the B. C. Electric company will construct at Jordan river will be under the direct supervision of Edward Carpenter, who will be engineer in charge. Wynn Meredith, the chief engineer of the B. C. Electric company, who prepared the plans of the Lake Buntzen power plant and other large works for the same corporation, will supervise the work and prepare all necessary plans. The company intends to complete the work as soon as possible.

## SEWERAGE AND WATERWORKS.

**Ontario.**

GUELPH.—The formal opening of the new waterworks by the Hon. J. M. Gibson, lieutenant-governor of Ontario, took place on Thursday, September 23rd. The new system provides a supply of pure, spring water, unsurpassed in quality, while the quantity is practically unlimited. The old plant was installed in 1879, at a cost of $173,948, and over a hundred thousand dollars have been expended during the past year in laying a pipe line some few miles from the city to tap large springs. A board of three commissioners, who gave their services gratuitously, had charge of the work. To the ordinary householder, the cost of water under the new arrangement will be less than nine dollars a year.

The city of Guelph is one of the most progressive of Canadian municipalities. Its population of 14,060 enjoys all the privileges of a modern city.

LONDON.—The city of London is having trouble with its system of sewage disposal, which is thought to be too small to carry away all the sewage. In some sections the sewers are practically choked up, and Mr. Willis Chipman, consulting sanitary engineer, of Toronto, has been called in to make recommendations.

OTTAWA.—Sewer extensions, to cost $1,500, made necessary by the proposed new G. T. R. station, will be built at an early date.

PORT ARTHUR.—The city will lay an intake pipe in connection with the waterworks system at a cost of $30,000 The pipe will go 3,500 feet out into Lake Superior, into thirty feet of water, where the supply is always pure, even on the surface, and where the depth makes the presence of impurities impossible. Mr. John Galt, C. E., of Toronto, has been consulted by the municipality.

STRATFORD.—The City of Stratford has been allowed three months in which to complete the enlargement of the sewage disposal works. Until the expiry of that time William E. Bean, a farmer, will not be able to press his motion for sequestration. Bean desires to place the sheriff in possession, alleging that the city has been guilty of contempt in ignoring the court's order of ten years ago. This order restrained the city from polluting the waters of the River Avon, which flows through Bean's farm. Mr. M. Ferguson is the city engineer.

## CEMENT—CONCRETE.

**Quebec.**

MONTREAL.—The Artificial Marble Company will receive a contract for concrete work in connection with the Lafontaine Park Road amounting to $3,650.

**Ontario.**

COLLINGWOOD.—At a recent council meeting, the town engineer recommended the erection of a cement arch over the canal on Fifth Street at a cost of $500. The Board of Works will report.

GUELPH.—On September 15th, the first sod was turned in connection with the Niagara power station. The building will be of concrete and brick.

NIAGARA FALLS.—The Ontario Power Company have just been granted permission to lay a reinforced concrete pipe from the gate-house to the power house at an estimated cost of one million dollars.

PETERBORO.—Messrs. Geo. A. Begy & Company, of St. Catharines, Ont., who were to build the new reinforced concrete bridge here, on Smith Street, have withdrawn their tender and the contract has now been given to Messrs. E. and F. Conroy, a local firm. Contract price, $28,457.

TORONTO.—A reinforced concrete bridge with a span of 120 feet clear and two spans of 100 feet may be erected by the city of Toronto across the River Don at Wilton Avenue. Until Monday, October 4th, Mr. Joseph Oliver, (Mayor), Chairman of the Board of Control, will receive tenders for its construction. A few weeks ago, tenders were called for a steel structure, and it looks as if the tenders for both steel and concrete structures will be compared before a decision is arrived at. Further particulars appear in our advertising columns.

**British Columbia.**

VANCOUVER.—Five sub-stations of concrete will be erected on the New Westminster-Chilliwack line of the British Columbia Electric Railway, and tenders are now invited for the work of erection.

VICTORIA.—The cost of paving Fort Street is estimated at $27,000. Concrete will be used for the foundation.

VICTORIA.—A reinforced concrete building with a British Columbia granite front will be erected here on Government Street, by Luney Bros., for the Royal Bank. Estimated cost, $50,000.

## FINANCING PUBLIC WORKS.

**Ontario.**

BRUCE MINES.—This municipality has recently sold $10,000 debentures to Messrs. Brent, Noxon & Co., Toronto.

COLDWATER.—At a recent public meeting of ratepayers it was unanimously resolved that council be asked to have a by-law submitted to the people at once to decide whether the village will install a system of fire protection alone at an approximate cost of $10,000 or a complete waterworks system at an approximate cost of $29,000.

HAMILTON.—Mr. S. H. Kent, city clerk, offers for sale $80,000 school debentures.

NEWMARKET.—Mr. J. E. Hughes, clerk and treasurer of this municipality, offers for sale $20,000 debentures until September 29th inst.

**Manitoba.**

BRANDON.—At the earliest possible date a by-law, to obtain permission for borrowing $13,000 for winter fair buildings, will be submitted to the ratepayers. It is intended to erect the buildings this fall.

**Saskatchewan.**

WYNYARD.—This municipality has sold to Messrs. Nay & James of Regina local improvements debentures amounting to $3,407.65.

**British Columbia.**

VANCOUVER.—The district of Peachland, B.C., sold to Messrs. Wood, Gundy & Co. $20,800 debentures. The money is required for waterworks, electric light, road improvements and fire protection.

VANCOUVER.—The civic finance committee have recommended to the council money by-laws aggregating $325,000 for the purchase of land at Kitsalano beach and English Bay.

VANCOUVER.—A draft for the Columbia St. Bridge by-law, recently prepared by the Bridge Committee of the City Council, calls for $675,000. The total cost of the bridge, approaches, compensation, and bond shrinkage will be $907,500.

## TELEPHONY.

**Saskatchewan.**

REGINA.—On Wednesday, Sept. 22nd, tenders closed with Mr. S. P. Porter, deputy commissioner of Railways and Telephones, for the construction of 'phone systems in Hanley and Melville.

The world's production of nickel last year is estimated at 12,800 metric tons, as compared with 14,100 metric tons in the previous year. The maximum recorded production was 14,300 metric tons in 1906. Of the total rather more than half is produced in Europe and the remainder in America.

## MARKET CONDITIONS.

Montreal, 22nd September, 1909.

The pig iron markets of the United States show an advance of 50 cents per ton. Bessemer pig is selling as high as $17.50 per ton, and it is very difficult to obtain any at less, a few sales being, however, reported at $17 at furnace as the higher figure. It would appear that none can be had for next year's delivery at less than $18. Basic pig is quoted in the vicinity of $17, but once the advance in bessemer is established, basic will also advance. Foundry iron is also selling at $16, but it is stated that sales have been made at 50 cents higher than that, and $17 is being demanded for next year. Another fact of much importance in the situation is the firmness in the price of coke. This, during the past two months, has advanced very considerably, and it seems to be the impression that by the beginning of next year $4 will be the regular price. Sellers are not looking for long time contracts. Good grades of foundry coke are quoted at $3.25 to $3.50 for immediate delivery. The buying of pig-iron is quite heavy at present though steel making iron is not very active as far as the actual buying for contracts is concerned.

In Great Britain the market is improving and prices are gradually advancing. Montreal interests state that the latest reports are certainly the best which have been received for at least 18 months past. Replies to cables show that the market is in a very firm position and that the tendency is upwards, no concessions being now obtainable on inquiries for large lots. In fact, quotations are given subject to immediate acceptance.

The situation in Canada is unusually encouraging. The output of the Dominion Iron and Nova Scotia Steel plants is practically not available for the open market, the requirements of these institutions for steel-making purposes absorbing almost all the iron they produce. London-derry, which has been shut down since last fall, remains so until about the end of this year. The Radnor furnace of the Canada Iron Corporation is working on charcoal iron, as is also the Deloro furnace. The Hamilton furnaces of the Hamilton Steel and Iron Company have been out of blast for some time and are under repairs, and deliveries with this concern are in arrears. The Midland furnace of the Canada Iron Corporation is now occupied with orders which will keep it operating for five or six months to come, so that the company is not anxious to make further contracts at to-day's prices. The Atikoken furnace, of the Atikoken Iron Company, is now in blast, but the grade of metal produced is not suitable for ordinary small foundries, being sold particularly to the large concerns as a mixture for other grades. The output of these furnaces is also contracted for for some months ahead. The situation in Canada, therefore, is that furnaces are well occupied, and there are absolutely no stocks of metal on hand. It would consequently seem that the furnaces would very shortly take advantage of the upward movement in the United States and Great Britain and ask higher prices for such deliveries as they are able to make.

Regarding the hope that Nova Scotia and Dominion Iron companies would reap very considerable advantages from the lowering of the import duty from 40 to 15 cents per ton on import iron entering the United States, it transpires that the contracts for the coming year were made with the understanding that the purchasers should receive the benefit of any reduction which might take place. Hence the Canadian companies will not be able to get the advantage of the 25 cent. reduction, at the present time. There is, however, an indication that the volume of the orders in the United States will be greatly increased. American foundries have recently contracted for about 250,000 tons of Wabana ore for delivery as quickly as possible.

Although merchants handling different lines of finished and semi-finished products of iron and steel report few or no changes, this week, they are uniformly of the opinion that advances in the near future are in order, the present tone of the market being unusually firm, throughout. Quotations are:—

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags repurchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¾-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.05; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 15 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.15 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.** Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $6.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50;

# STRUCTURAL STEEL

| | | |
|---|---|---|
| ANGLES | BEAMS | PLATES |
| BARS | CHANNELS | TEES |

LET US QUOTE ON YOUR SPECIFICATION

**A. C. LESLIE & CO., Limited**
**MONTREAL**

5


1-inch, $16.50, 1¼-inch, $22.50, 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $118.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ¼, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $11 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shatting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, September 23rd, 1909.

Advices from the Old Country indicate improved conditions in iron and steel. Demand, both domestic and external, is better, and the labor troubles, long so threatening, have pretty well subsided. In the United States, prices of iron and steel are firm and higher, with production stimulated by an active demand from railways. Canadian furnaces are well employed and have orders ahead for some months.

Wholesale business in Toronto is fairly active in various lines, iron and steel and other metals not the least so. Building continues in the city, of dwellings especially, at a rate which causes prudent observers alarm lest overdoing in this direction may cause a reaction which must seriously affect real estate dealers and speculative builders. A better feeling begins to appear in cement, while bricks appear to be as active as ever. Lumber is firm in tone. Roofing material active and steady.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $13; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Shipments are fairly heavy, mainly on existing contracts, and not much new business is offering. An indication of a disposition towards greater stiffness in the market is afforded by the following quotation made to-day by a large producing company:—"Our price to-day for Portland cement, f.o.b. Toronto, is $1.70 net cash including cotton bags, for acceptance within 10 days from date of quotation, and for shipment within 30 days from date of acceptance." According to stories in the newspapers, the cement merger is assuming shape. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra; in shop, $1.35. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

**Detonator Caps.**—75c. to $1 per [illegible], case lots, 75c. per [illegible], broken quantities, $1.

**Dynamite,** per pound, 21 to 22c., as to quantity.

**Roofing Felt.**—An improvement in demand [illegible] late, [illegible] which is $1.80 per [illegible] lbs.

**Fire Bricks.**—English and Scotch, $[illegible] to $45, American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $[illegible], 6 feet, $[illegible], 8 feet, $5.50, 10 feet, $6. Single strength, 4 feet, $4.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $[illegible] per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand Sheets [illegible] 8 feet long, 30 or [illegible] inches wide, 1 gauge, $2.90; 12-14 gauge, $2.90; 16, 18, 20, $2.[illegible], 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15, [illegible], $4.15 per 100 lbs. Fleur de Lis—gauge, $4.50; 26-gauge, $4.25, per 100 lbs. This downward change is the result of dissolution of an agreement between British and United States makers.

**Iron Chain.**—¼ inch, $4.[illegible]; 5-16 inch, $5.15, ⅜ inch, $4.15, 7/16 inch, $3.95; ½-inch, $3.75; 9-16 inch, $3.[illegible], [illegible] inch, $3.55, ⅝ inch, $3.45; [illegible] inch, $3.40; 1 inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ⅛ inch, $2.03; [illegible] inch, $2.[illegible], ¼ inch, $2.63; [illegible] inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $24.[illegible], 4-inch, $29.[illegible], 4½-inch, $[illegible], 5 inch, $43.50; 6-inch, $56. Galvanized, ⅛-inch, $2.80; [illegible]-inch, $3.68, ⅜-inch, $3.48, ½-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44, 1½-inch, $[illegible], 2-inch, $13.[illegible], per 100 feet. Talk is still heard of an advance, but nothing definite.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per [illegible] lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs f.o.b. car. Demand is good.

**Lumber.**—Although prices are stiffening generally, there is no freedom in buying shown by country dealers in Ontario, who continue to order "from hand to mouth." It is the city trade building being still active, which still absorbs the attention of producers or large merchants. Some sizes of native pine, for example, 2-inch good and 10 x 12 inch stock, are becoming scarce. British Columbia shingles are easier; everything else on the list appears to be on the upward trend according to outside advices. The almost wonderful demand from builders in the city, however, continues, and the keen competition to fill it makes the market almost a buyers' one. We quote dressing pine $32 to $35 per M, common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch, for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—An improved request is noted lately, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10x16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. of list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price unchanged at 31½ to 32c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is very firm at $5.75 to $6 per 100 lbs.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods.**—Peas, 90½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 13c.; twins, 13½c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 6 to 6¾c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¾c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Scarce and higher. Tierces, 15¼c.; tub, 15½c.; pails, 15¾c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Still advancing. Short cut, $27.50 per barrel; mess, $26.

**Rice.**—B grade, 3¼c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¾ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 10 to 45c.

* * * *

Winnipeg, September 21st, 1909.

There is no let up in the amount of work being done in Winnipeg, and the prospects for an exceptionally busy fall are very bright. The carpenter's strike is reported to be over, and every available man is being put to work. The demand for all lines of builders' supplies is still strong, and dealers have no cause for complaint at the season's business. The hardware trade is possibly a little quiet just now, particularly in the country, as farmers are in the midst of threshing and getting their grain marketed. Country merchants, however, have laid in large stock, and their business in the near future will be decidedly more brisk.

The commercial condition in the West was never better than it is now, and people are in better shape financially, and more able to invest in new buildings and improvement work than they have been for some time. There has been a sharp advance in Winnipeg in the price of pork, which will be felt by railroad contractors and those having to feed large gangs of men. The retail price of bacon has gone up, at the rate of from 5c. to 8c. per lb., and the price of hogs, which for some years has averaged 6½c. per lb. live weight off the cars, has advanced to 9c. per lb. All quotations on builders' material remain steady, and the demand continues to be strong.

Winnipeg prices are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Wankegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; culled or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hinges.** Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75, 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$[illegible] per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2x[illegible] x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

**Nails.** $4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

**Picks.** Clay, $5 per dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

**Pipe.**—Iron, Black, per 100 feet, ½-inch, $2.50; ⅜-inch, $2.80; ¾-inch, $[illegible]; 1-inch, $[illegible]; 1¼-inch, $6.60; 1½-inch, $9; 1¾-inch, $10.75; 2-inch, $[illegible]; galvanized, [illegible]-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $[illegible]; 1½-inch, $[illegible]; 2-inch, $18.10. Lead, 6½c. per lb.

**Pitch.** [illegible], $[illegible] per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.** [illegible] barrel, $3.

**Roofing Paper.** [illegible] 2½c. per roll.

**Rope.**—[illegible] in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn [illegible] c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c.; sisal, 11c.

**Spikes.** [illegible] follows—[illegible] 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; [illegible] x 6, [illegible], $4.25; [illegible] x 8, 9, 10, and 12, $4.65, 25c. extra on other sizes.

**Steel Plates, Rolled.** [illegible] in., $3.15 base, machinery, $3 base; share, $[illegible] share [illegible], $4.25, cast share steel, $7.50; toe calk, $4.50 [illegible], tire steel, $3 base, cast tool steel, lb., 9 to 12½c.

**Staples.** [illegible], $3.[illegible] per 100 lbs.

**Timber.**—Rough, 8 x 8 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, [illegible] dressed, $[illegible] to $48.25.

**Tool Steel.** [illegible] 15c. per pound.

**Wire.**—Oiled [illegible] annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.[illegible]; 11 gauge, $3.[illegible]; 12 and 13 aguge, $3.20; 14 to 16 gauge, $3.25 to $3.[illegible], [illegible] extra for galvanizing.


## POSITIONS WANTED

Advertisements under this heading two cents a word.
Displayed $1.00 an inch.

**AN EXPERIENCED** Engineer-Contractor desires partnership or engagement with a live Construction Company or Contractor, on railroad or municipal work. Apply, Box 38, Canadian Engineer.

**CIVIL ENGINEER** with practical experience in Sewage Disposal, Waterworks, General Municipal Work, desires permanent position. References. Box 44, Canadian Engineer, Toronto.

## POSITIONS VACANT

Advertisements under this heading, two cents a word.
Displayed $1.50 an inch.

**INSTRUCTION IN REINFORCED CONCRETE.** — Gentleman requires instruction in reinforced concrete. State terms. Box 42, Canadian Engineer.

# University of Manitoba

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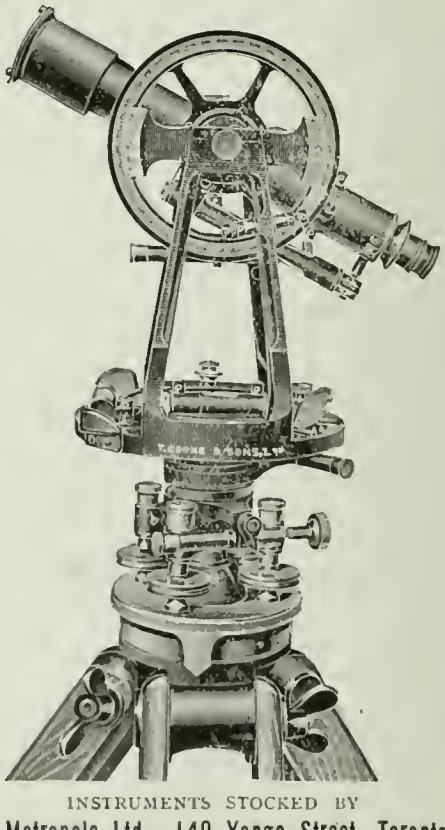

INSTRUMENTS STOCKED BY

The Art Metropole Ltd., 149 Yonge Street, Toronto
The Hughes Owens Co., Ltd., 237 Notre Dame W., Montreal
Messrs. Ruttan & Chipman, Fort Garry Court, Winnipeg

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, OCTOBER 1st, 1909. No. 13



## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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**HEAD OFFICE: 62 Church Street, and Court Street, Toronto**
TELEPHONE, Main 7404.

**Montreal Office:** B33, Board of Trade Building. T. C. Allum, Editorial Representative, Phone M 1001.

**Winnipeg Office:** Room 315, Nanton Building. Phone 8142. G. W. Goodall Business and Editorial Representative.

**London Office:** 225 Outer Temple Strand T. R. Clougher, Business and Editorial Representative, Telephone 527 Central.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

**NOTICE TO ADVERTISERS**

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

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TORONTO, CANADA, OCTOBER 1, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## TRACK ELEVATION.

We give elsewhere in this issue an abstract from a report on "Track Elevation in Chicago." The elimination of grade crossings in Canada has just commenced. As the population becomes more dense the demand for subways and viaducts will increase. As the time element becomes a greater factor in railway competition and as the volume of traffic increases the railroad companies will more willingly undertake this work.

In this country some care must be exercised in the demands we make on the railway in connection with such work. In the case of new roads and branches being built a certain amount of grade crossing elimination may be provided for. To require railways to spend millions to protect crossings that may be effectively protected more cheaply in other ways will always be a waste and misfortune.

Chicago has been fortunate in the track elevation work because the railways were as anxious as the municipality to undertake the work. The time saved, the fewer accidents and their costs, which include investigations, wreckage and damages paid, and the more certain connections lessen the strain and tend for efficient railway operation.

## ENGINEERING EDUCATION AND COMMERCIAL LIFE.

This week sees our colleges of Applied Science opening for another year of academic work. These colleges have achieved such splendid success in the balancing of their course of study, in the efficiency of their teaching, and their graduates have attained such prominence in the world of affairs and business that it is not to be wondered at a large number of young men desirous of securing a university training before entering business and commercial life should of their volition choose a training in a science college.

It is fortunate that at least one department of our universities has enough of the "practical" to attract and enough of the "theory" to train. Not that practical subjects do not train nor theory attract, but it requires a judicious combination of the two to interest the young man of to-day.

The closer the courses of study and the methods of teaching parallel the conditions found in actual affairs, the more popular will the course become.

## FREE ENGINEERING ADVICE.

In our issue of September 3rd Mr. T. S. Scott, Assistant City Engineer of Toronto, had a most interesting letter on "Free Engineering Advice." In his communication Mr. Scott pointed out the fact, well known to many engineers, that members of the engineering staff of cities were frequently requested to give free much advice that should be paid for with a large fee.

Mr. Scott's letter drew forth many replies, but unfortunately those sending the communications with

but one or two exceptions would not allow their names to appear with their letters; therefore we have thought it wise not to publish any of the opinions expressed anonymously.

One of the engineers employed by a Canadian railway writes:—

> In connection with applications of the various rural telephone companies for approval of overhead wire crossings, we receive many drawings which might be quite appropriately described as pictorially diagrammatic. In many cases they almost require a cipher code to make them explanatory. These works of art certainly never came from the pen of a draftsman, and are done in this way simply to save the expense of having some local engineer prepare them. At times we receive pencil sketches and are asked to furnish plans, which, of course, we do not do. We inform the applicant to have the plans prepared by some local engineer. The above is, perhaps, not a parallel case to that referred to by Mr. Scott, but it simply goes to show that the general attitude prevailing is to try to eliminate, if possible, the engaging of professional help.

A city engineer in the West finds that the inquiries from outsiders are so numerous that he has not the time for outside work, and writes:—

> It seems to me that engineers in the employ of municipalities usually find that the nominal office hours are not sufficient to do the work incumbent on them, and depend on the time when the day's routine work is over to solve the really difficult engineering problems. And so, while professional ethics demand that "visiting or corresponding engineers be treated with every courtesy," to all other enquirers my reply is a polite but firm refusal.

A county engineer who has had wide experience on drainage work relates a story of a laborer who came up to where he was working with the level and said: "Where can I get one of those machines to look through. If I could get one I could make lots of money."

Evidently he did not realize that the mechanical doing of work was a very small part of engineering.

Another engineer tells of an interesting experience in municipal work, and, although it does not come under the head of "Free Engineering Advice," yet it is worth giving, illustrating, as it does, the mistakes many municipalities make in not employing engineers.

> I recall one instance, he says, where the council deemed it advisable to place a farmer in charge of the construction of concrete abutments and piers. A local contractor on the work juggled the mixture of the ingredients, resulting in poor concrete elevation of the top of piers, and the bridge seats were all wrong. I asked why a township engineer had not been instructed to lay out and look after the work, and was informed that they did not consider the proposition would warrant having their engineer look after it. This case resulted, I understand, in the rebuilding of all the work and the ultimate supervision of the township engineer, so I feel certain that the township council will not in future launch out for themselves in such matters.

Although there is not in the eyes of the law any such person as an engineer, yet gradually the community is learning to appreciate their work and status.


# The Engineers' Club of Toronto

96 KING STREET WEST TELEPHONE MAIN 4977

## Programme for October, 1909

THURSDAY, 7th, 8 p.m.:
Opening Meeting of the Season.
Informal Smoker and Discussion on Club Affairs.

THURSDAY, 14th, 8 p.m.:
"Engineering Laboratories and Workshops in Europe."
Paper by Prof. R. Angus.
(Illustrated by Lantern Slides).

THURSDAY, 21st, 8 p.m.:
"The Air as a Medium of Transportation."
Paper by Mr. J. F. d'Almeida.

THURSDAY, 28th, 8 p.m.:
Meeting of Toronto Branch of Canadian Society of Civil Engineers.

THE EXECUTIVE MEETS EVERY THURSDAY AT 7.30 P.M.

A. B. BARRY, President, City Hall.
L. J. STREET, Treasurer, 37 Melinda St.
R. B. WOLSEY, Secretary, 25 Lowther Ave.


## PERSONAL NOTES.

MR. JOHN GALT, C.E., of Galt & Smith, Consulting Engineers, Toronto, who has been in the West for over a year is again in Toronto, on a short visit. Mr. Galt expects to return to British Columbia shortly.

MR. RAOUL MONSERAN, of the Department of Public Works, in France, arrived in Montreal this week with instructions to make a study of the harbor works with a view to applying the knowledge to the improvement of seaport towns in France.

MESSRS. CHAPMAN & WALKER, who have lately formed a partnership and located at 69 Victoria St., Toronto, Ontario, are representing a number of large Old Country firms. The following are some of the companies: Messrs. Dick-Kar & Co., Preston, Eng.; Crossley Bros., Manchester, Eng.; Henley's Telegraph and Cable Co.; Messrs. Pritchetts & Gold, manufacturers of storage batteries; Messrs. Holder Bros. & Thompson, electrical instrument manufacturers; The Z. Tungsten Lamp Co., etc., etc. Messrs. Chapman & Walker have the sole Canadian agency for all of these firms.

The School of Mining, of Kingston, Ontario, recently made the following appointments: Mr. W. O. Walker, M.A., who had been offered the professorship of chemistry in a western college was advanced from the position of lecturer to that of Associate Professor. The positions formerly held by Dr. Firth and Dr. Dickson have been filled by the appointment of Walter D. Bonner, M.A., and Rodger J. Manning, M.A. Mr. Bonner graduated at Nebraska, Wesleyan University, where he obtained the degree of M.A. During the past year he has been completing his work for the Ph. D. degree, as well as assisting with the teaching, at the University of Toronto. Mr. Manning is a Canadian and received his education in Chemistry at the University of Toronto. Since graduation in 1906, he has been teaching the subject, as well as working for the Ph. D. degree, at his Alma Mater. He comes to the School of Mining with the best of recommendations. The Fellowship in Chemistry established by

Dr. Milton Hersey of Montreal, has been filled by the appointment of Mr. J. A. McRae, M.A., a recent graduate of Queen's. Mr. McRae will do research work and assist with the teaching. Mr. J. K. Robertson, M.A., who has been appointed lecturer in Physics, was born in Perth in 1885 and was educated in the public schools and collegiate institute of Perth. He matriculated at the University of Toronto, in 1903, receiving scholarships in mathematics, classics and general proficiency. During his first year he was scholarship man in mathematics and physics. He received the degree of Bachelor of Arts in 1907, with first class honors in the department of physics. In 1908, he received the degree, Master of Arts, his thesis being "On the Charges Gained by Insulated Metallic Conductors, surrounded by other Conductors, and the Relation of these charges to the Volta Effect." This paper was published in the Physical Review. Mr. Robertson has also worked with Professor McLennan on "The Magnetic Properties of Heusler's Alloys," the results being published in the Physical Review, and with H. A. McTaggart on "The Temperature Variations in the Specific Resistance of Heusler's Alloys," the results being published in the Transactions of the Royal Society of Canada. Mr. Robertson comes very highly recommended and will undoubtedly be a valuable member of the Science Faculty.

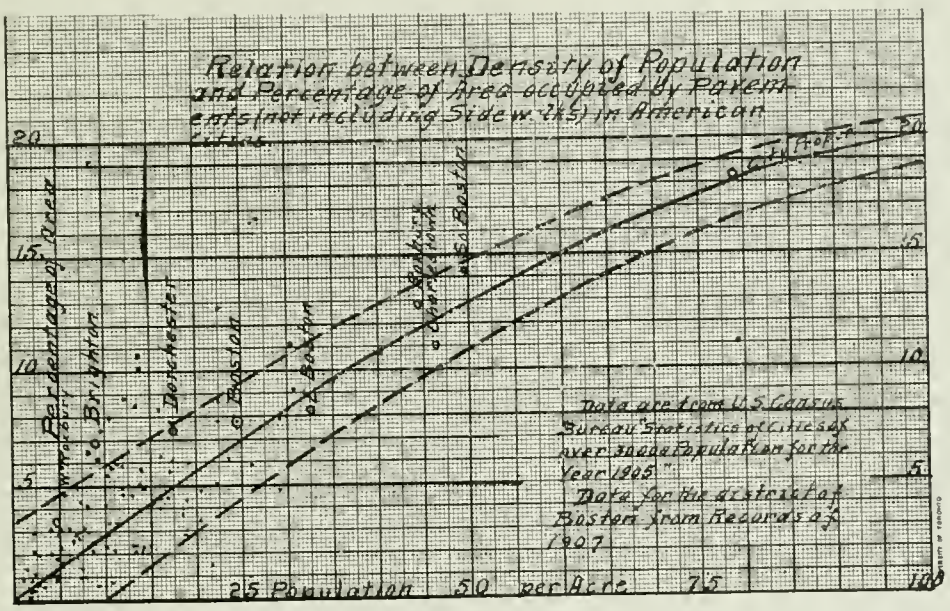
MR. LEO. F. GUTTMAN, Ph. D., F. I. C., A. C. G. I., has been appointed as assistant professor. Dr. Guttman has had a distinguished career both as a student and as a teacher. He is a son of Dr. Oscar Guttman, the English authority on Explosives. He spent three years at Central Technical College, London, where he obtained the Diploma as Civil Engineer (A.C.G.I.) He then attended the University of Heidelberg, Germany, where he studied Chemistry for four years, obtaining the degree of Ph. D. (multa cum laude.) After this he was assistant to Sir William Ramsay, University College, London, for two and one half years. He then left England as Chief Carnegie Research Assistant to Professor Baskerville at the College of the City of New York, where after six months, he was appointed to the teaching staff of the same college. After four years teaching experience in New York he now comes to the School of Mining. The extent and completeness of Dr. Guttman's training should make him a highly valued member of the staff of the department of Chemistry.

## RELATION OF PAVEMENT AREA TO POPULATION.

For the purpose of determining the relation existing between the population of a given community and the requisite amount of street surface, Metcalf & Eddy, consulting civil engineers of Boston, recently prepared a diagram showing the relation of the density of population to the percentage of the area of the city devoted to pavements in all cities in the United States having a population of 30,000 or more. This diagram, recently published in the report of the engineers to the Boston Finance Commission, is reproduced herewith. Based upon these data a curve was drawn showing the average conditions in cities of various densities of population. Two additional lines, one above and the other below the curve, varying from each other by from 6 per cent. at the lower densities to 2 per cent. at the higher densities, show that a large proportion of the cities fall within these limits, thus indicating that the variation from the plotted curve showing the average conditions is comparatively small.

The data for this diagram were taken from the Special Report of the Department of Commerce and Labor, Bureau of the Census, giving the statistics of cities having a population of over 30,000 in 1905. It is quite probable that the figures indicating the amount of street pavements in various cities, as given in these reports, include unimproved streets, whereas the figures used for Boston and the subdivisions of Boston represent only public streets. If, however, this difference exists, the diagram would indicate more rather than less the normal amount of pavement on public streets.

The districts having the densest population are those of Manhattan, Boston (city proper), Hoboken, South Boston, Charlestown and Roxbury. Unfortunately, these are the only very densely populated communities from which data were obtainable with which to establish the curve of relation of population to the proportionate area of street surface. On this account it is obviously unfair to base on such meagre data a curve showing the proper relation of street areas to population, unless it is deemed that the existing relation in Boston is proper and requisite to the public needs.


Relation between Density of Population and Percentage of Area occupied by Pavements (not including Sidewalks) in American Cities.
Percentage of Area
Brighton
Worcester
Boston
Boston
Roxbury
So. Boston
City of Boston
Data are from U.S. Census Bureau "Statistics of Cities having over 30000 Population for the Year 1905"
Data for the districts of Boston from Records of 1907
25 Population 50 per Acre 75 100

## COMING MEETINGS.

**American Society of Engineering Contractors.**—Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secretary, Daniel J. Hauer, Park Row Building, New York, N.Y.

**American Society of Mechanical Engineers.**—December 7-10, 1909. Annual meeting New York City. Secretary, Calvin W. Rice, 29 W. 30th Street, New York, N.Y.

**American Street and Interurban Railway Association.**—October 4-8, 1909. Annual convention at Denver, Colo. Secretary, Bernard V. Swenson, 29 W. 39th Street, New York, N.Y.

**National Municipal League.**—November 15-19, 1909. Annual meeting Cincinnati, O. Secretary, Clinton Rogers Woodruff, 705 North American Building, Philadelphia, Pa.

(Continued on Next Page).

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Sept. 21 1909 | EARNINGS Week of Sept. 21 1908 | STOCK QUOTATIONS TORONTO Price Sept. 24 '08 | Price Sept. 16 '09 | Price Sept. 23 '09 | Sales Week End'd Sep. 23 | MONTREAL Price Sept. 2 08 | Price Sept. 16 09 | Price Sept. 23 '09 | Sale Week End'd Sep. 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $1,885 000 | 1,471.000 | ..... | 182½ | 181¼ 182¾ | 182 300 | 172 | 171⅝ 182¼ | 182 182¼ | 182 1605 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 270 000 | 209,700 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 933.213 | 855.192 | ..... | ..... | *1st. pref. 107½, 3rd pref. 68⅜, ordinary 24¾ | ..... | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | 33,814 | 17,669 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138 3 | 18,000 | 100 | 80,881 | 72,459 | ..... | ..... | ..... | ..... | 183 | 181 214 | 213½ 215 | 214½ 302 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75.080 | 70,331 | 102½ | 102½ 124½ | 124¼ 124¾ | 85 | 102½ | 102 124½ | 124¼ 124¼ | 124⅝ 759 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 162½ | 161 187 | 187½ | 90 | 164½ | 187 | 187½ | 45 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## T. AND N.O. RAILWAY.

### Ontario Government Road Now Paying Its Way.

The Temiskaming and Northern Ontario Railway is now paying its way. Hon. A. J. Matheson, the Provincial Treasurer, announced recently that the net receipts from operation for the seven months ending July 31st were $379,698, while the proportionate share of the interest at four per cent. on the expenditure of construction and operating the entire system was $350,000. The announcement, while anticipated for some time, signalizes a new era for the people's railway. The minister's returns show that the gross earnings from operation in July were $148,111, with expenditures of $75,587, a net earning of $70,524, which, with $9,813 received in royalties, brings the total for the month to $80,337, as against $29,584 for the same month last year.

## CAPE BRETON ELECTRIC COMPANY.

The following is a comparative statement of the earnings of the Cape Breton Electric Company for the months of July, 1908 and 1909, and for the seven months ending July of each year:—

| | Gross. | Net. |
|---|---|---|
| July, 1908 | $ 21,333.83 | $ 9,455.03 |
| July, 1909 | 21,872.40 | 8,862.38 |
| 7 months, 1908 | 136,859.56 | 54,419.81 |
| 7 months, 1909 | 126,383.78 | 43,492.14 |

## ONTARIO ELECTRIC RAILWAYS.

### ONTARIO RAILWAY AND MUNICIPAL BOARD.

The Ontario Railway and Municipal Board was created by Act of the Ontario Legislature in 1906 (see Chapter 31, 6 Edw. VII. Statutes of Ontario, 1906).

The present members of the Board are James Leitch (chairman), A. B. Ingram, vice-chairman, and H. N. Kittson.

### CORNWALL STREET RAILWAY.

President, James Taske.
Manager, William Hodge.
Chief Engineer,
Purchasing Agent,
**Kind of Road:** Street Railway.
**Length of Road:**
Single track.
Total in single miles, six miles.
**Character of Service:**
Car equipment, General Electric, 800.
Number of motors, 2; power of motors, 20 h.p.
Method of controlling, K2.
Method of braking, hand.
Gauge of track, 4 feet 8½ inches; weight of rails, 60 lbs
**Power:**
Direct current, D.C.
Voltage of transmission, 550.
Trolley voltage, 500.

### BRANTFORD AND HAMILTON RAILWAY.

President, J. W. Sutherland.
Manager, E. P. Coleman.
Chief Engineer, W. C. Hawkins.
Purchasing Agent, J. B. Guffeth.
**Kind of Road:** Interurban.
**Length of Road:**
Double track, 0 miles.
Single track, 22.91 miles.
Total single miles, 22.91.
**Character of Service:**
Car equipment, six 65 foot cars; type, Brill.
Number of motors, 4 each car; power of motors, 75 h.p.
Method of controlling, Westinghouse 4 controller.
Method of braking, straight air.
Gauge of track, 4 ft. 8½ in.; weight of rails, 80 lbs.
**Power:**
Direct current for power.
Alternating current for transmission.
Voltage of transmission, 40,000.
Trolley voltage, 600.
Frequency of transmission for A.C., 66⅔.
Number of phases, 3.

### CHATHAM, WALLACEBURG AND ERIE RAILWAY.

President, G. W. Kipp, Towanda, Pa.
Manager, R. G. Young, Chatham.
Chief Engineer, P. J. Shields, Chatham.
Purchasing Agent, R. G. Young, Chatham.
Secretary, J. G. Kerr.
**Kind of Road:** Interurban and Street Railway.
**Length of Road:**
Double track, 0 miles.
Single track, 38 miles.
Total in single miles, 38.
**Character of Service:**
Car equipment, 101 B.; type, Westinghouse.
Number of motors, 20; power of motors, 50 h.p.
Method of controlling, Westinghouse controller.
Method of braking, air-brake automatic Westinghouse.
Gauge of track, 4 ft. 8½ in.; weight of rails, 60 lbs.
**Power:**
Direct current, D.C.
Voltage of transmission, 550.
Trolley voltage, 550.

**COMING MEETINGS.**—Continued from previous Page.

**Oklahoma Cement Users' and Contractors' Association.** September 29, October 8, 1909. Annual meeting, Oklahoma City, Okla. Secretary, D. C. Patterson, Scott-Thompson Building, Oklahoma City, Okla.

**Railway Signal Association.**—October 12-14, 1909. Annual convention at Louisville, Ky. Secretary, C. C. Rosenberg, Bethlehem, Pa.

**American Public Health Association.** — October 19-22. Annual convention at Richmond, Va. Secretary, Charles O. Probst, Columbus, Ohio.

**Association of Car Lighting Engineers.**—Annual meeting at the New La Salle Hotel, Chicago, Ill. Mr. E. W. Jansen, chairman, committee on publicity, Illinois Central Railway Company, Chicago.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## ADMINISTRATION OF HEALTH QUESTIONS BY CENTRAL AUTHORITIES.

As far as the questions of sewerage, sewage disposal, and water supply are concerned there can exist no doubt but, that, such questions must be settled and administrated by a central authority.

In Canada owing to the fact that the Dominion is divided into Provinces, the central authorities must necessarily be invested in the Provincial Governments.

Whether or not a supreme authority acting as a Court of Appeal should not be provided by the Dominion Government is a matter of policy which requires attention at Ottawa.

Dr. Hodgetts, the Secretary for the Provincial Board of Health of Ontario, is decidedly in favor of a supreme central authority at Ottawa, directed by able medical men and engineers, who can keep in touch with the work done in other countries as well as studying local conditions, so that it may be in a position to advise the several Provinces throughout the Dominion.

We must certainly agree with Dr. Hodgetts. In fact, his aim appears to be the establishment of an authority in Canada on the same lines (or improved) as that of the Local Government Board of Great Britain.

At the same time, owing to the great extent of territory in Canada, much must be done and left to the Provincial authorities.

What is being done at the present time by Provincial authorities is a mere flea bite compared with what ought to be done.

Provincial Boards of Health are all very well as at present constituted in Ontario and Quebec as a means of obtaining statistics of deaths from various diseases, and isolating diseases, which may, if left unattended, become epidemic. But what are these boards doing as central advising authorities to the various municipalities under their jurisdiction? Practically nothing! They have practically no data to hand out to the aspiring municipality, either as regards water supply or efficient sewerage or sewage disposal. They simply sit still and wait to see what each and every individual village, town, or city may do, and then after the event may criticize.

Now, what is really wanted, before we talk of a Dominion central authority dealing with these matters, is that every Provincial Government has an organized staff in its health department capable of giving just the exact advice required to its several municipalities upon questions of efficient and good water supply, general sanitation and purification of sewage, so that the present sources of water supply may be kept pure.

Mr. T. Aird Murray at Winnipeg, lecturing before the city council and others last week, made this point an issue. At present the city of Winnipeg discharges the whole of its sewage in a raw state into the Red River and Assiniboine. The local press have been raising a cry against this pollution. The point which Mr. Murray raised is simply this, that there is no provincial legislation on the subject, and even if Winnipeg purified its sewage, that these streams would still be polluted by Portage la Prairie and Brandon above Winnipeg.

The question is not a municipal one first, but a provincial one first and a municipal one second.

The Province of Saskatchewan have taken up this matter as a provincial question, and are about to frame laws and regulations dealing with the whole question on lines similar to those adopted by the State Boards of Health in the United States. Until Manitoba can see its way to adopt similar legislation little can be done, either at Winnipeg or any of the other large centres of population in the Province either to improve the quality of the water in the rivers or the general health of the people.

## WATER STERILIZATION AT BOONTON, N.J.*

**By George A. Johnson, Consulting Engineer, New York City.**

The purpose of this paper is to describe the methods of operation followed during the first three months' operation of the sterilization plant of the Jersey City Water Supply Company at Boonton, N.J., the historical phases of the subject and a description of the process and the plant at Boonton have been given in papers of Dr. Leal and Mr. Fuller. In this paper, therefore, only the methods of operation will be described, together with a discussion of the results of analyses of the raw reservoir water and the treated water made in the laboratory of the water company at Boonton and in the laboratories of Dr. George E. McLaughlin, at Jersey City, and Dr. Wm. H. Park in New York City.

Force Employed.—From September 26th to December 31st, 1908, the operation of the sterilization plant at Boonton was under the direct charge of the writer. During that period Messrs. H. C. Stevens and Guy Britton were engineering assistants dividing the duties of the 24 hours of each day, and Mr. L. R. Whitcomb was analyst.

The duties of the engineering assistants were to superintend the preparation of chemical solutions and the application thereof to the water; to prepare accurate records of the rates of application of the sterilizing agent to the water; to collect and test at frequent intervals samples of the chemical solutions in order to ascertain the variation in strength of the same; and to prepare daily reports showing all necessary details of operation. Mr. Whitcomb's duties were to collect and analyze at least once a day samples of the raw reservoir water and of the water after treatment at a point on the aqueduct about one-mile below the point of application of the sterilization agent; and, also, to carry on incidental studies to show the effect of the treatment on particular forms of bacterial life.

In the beginning each of the tanks in which the chemical solutions were mixed and stored was carefully calibrated and tables prepared showing the content of each tank at different depths. The orifices whereby the flow of solution was regulated were also carefully calibrated and tables prepared showing the discharge through each orifice under a constant head with the orifice opened to a varying degree. With a knowledge of the amount of water which was being delivered into the aqueduct, it was possible by means of these tables

*Read before American Waterworks Association.

to adjust at the orifice the dose of chemical solution with a great degree of accuracy in a moment's time.

The bleaching powder was received at the plant in sheet-iron drums holding about 750 pounds, net. This powder was of a high degree of purity as ascertained by frequent analyses of it during the period of operation mentioned. Ordinarily the powder ran about 35 per cent. in "available chlorine," equivalent to 7.9 per cent. available oxygen. For the majority of the time solutions of 1 per cent. strength were used. For a part of the time, as is the case now, ½ per cent. solutions were used. By a ½ per cent. solution is meant the addition of 5 pounds of dry bleaching powder to each 1,000 pounds of water.

In making up a solution the amount of old solution remaining in the tank was first ascertained from the depth recorder and then it was decided to what height the tank was to be filled. By referring to the proper table showing the capacity of the tank between these two gauge readings it was then possible to figure the amount of dry bleaching powder necessary to add to make up a solution of the desired strength. This amount of dry powder was then dumped into the dissolving compartment of the mixing tank, raw water turned on, and the agitators started. The solution rising in the dissolving compartment overflowed into the main solution tank, which was filled to the required height through this overflow.

When it was desired to throw a tank into use the proper valves were opened, connecting the suction in this tank with the chemical feed pumps. The solution was tested by the Penot method for its strength in available oxygen by the so-called "available chlorine" method and the orifice on the orifice tank adjusted to give the required dose.

The chemical feed pumps were always operated so as to pump a quantity slightly in excess of that discharging through the orifice, and this excess escaped from the tank through an overflow pipe leading back into the main solution tank. In this manner it was possible to maintain at all times a constant head over the orifice and if, for any reason, the feed pumps stopped, the level of the solution in the orifice tank immediately began to fall, causing an alarm to be rung notifying the operator of the fact. Very little trouble was experienced from clogging at the orifice, and the variation in rate of application of the chemical solution was, therefore, exceedingly slight, but practically negligible.

In the beginning, not having a thoroughly definite idea of the smallest quantities which could be used with satisfactory results, the amount of chemical applied was 1.4 parts per million of "available chlorine," corresponding to 0.3 part per million of potential oxygen, or 36 pounds of dry bleaching powder per million gallons of water treated. Gradually the quantity of applied chemical has been decreased until at the present time about 0.2 part per million "available chlorine" is being applied. This corresponds to 0.045 part per million of potential oxygen, or 5 pounds per million gallons of the bleaching powder.

There has been no striking evidence that the higher quantities were more efficacious in the destruction of bacterial life in the raw reservoir water than the small quantity last mentioned. The composition and temperature of the raw water apparently affected not at all the rapidity and completeness of the sterilizing action.

A long series of analyses were made with a view to establishing if possible a relationship between the amount of carbonaceous organic matter in the raw water and the amount of sterilizing agent necessary to effect the desired degree of sterilization. The quantities of the sterilizing agent used were so small, however, that there was found to be no such relationship existing. In other places, where the amount of organic matter is much higher than in the raw Boonton water, it is possible that such a relationship may be found to exist.

Records were tabulated showing the amount of water treated each day, the amount of chemical agent applied, expressed in parts per million of potential oxygen, the results of bacterial examinations to show numbers of bacteria in the raw and treated water, and of tests for B. coli communis carried on at Boonton and in the laboratories of Drs. Park and McLaughlin.

If there is an apparent disparity in the results of analyses of the treated water at the Romine gate house and at the point of delivery in Jersey City, 23 miles below, and if the numbers of bacteria at the latter point were higher than those at the Romine gate house, as they sometimes were, it shows either that bacteria were still being washed from the old deposits in the conduit, or that there was a slight multiplication among the harmless forms of bacteria which successfully resisted the treatment. The completeness of the sterilizing action, so far as the destruction of objectionable forms is concerned, is apparent from the results. From October 10th to December 31st, inclusive, the total number of bacteria in the treated water at the point of delivery in Jersey City averaged 15 per cubic centimeter, and only on one occasion out of 455 tests was B. coli positively isolated from the treated water at the point of delivery in Jersey City, namely, on November 1st, 1908, when it was isolated by Dr. Park in 5 cc. of treated water collected at the Summit Avenue gate house in Jersey City.

Some time after the sterilization plant was put into service studies were inaugurated to demonstrate the efficiency of electrolytically-prepared hypochlorite of sodium. An electrolyzer was obtained from the National Laundry Machinery Company, of Dayton, Ohio, and this machine was set up in the gate house at Boonton and studies began. This electrolytic cell is of porcelain-lined pottery clay containing carbon electrodes and glass and carbon baffles. A solution of common salt of abont 4.5 per cent. strength and having an initial temperature of about 65 deg. Fahrenheit was run through this cell at a rate of about 2 cubic feet per hour in the presence of a direct electric current of 110 volts and 22 amperes. The yield of a single cell was about 0.6 pound of available chlorine per hour.

Between the dates of March 20th and 24th, 1909, a comparative test was made on the raw water to determine the relative efficiency of hypochlorite of lime in the form of bleaching powder and sodium hypochlorite electrolytically prepared. A considerable number of determinations of the bacterial quality of the raw and treated water before, during and after the use of the sodium hypochlorite solution showed that when equal quantities of the germicide in these two forms were added to the raw reservoir water the efficiency, so far as the destruction of bacterial life was concerned, was the same.

Under the existing circumstances the total cost which can be charged against the process when using bleaching powder was found to be $0.14 per million gallons of water treated, this figure being divided up substantially as follows, basing the figures on an average daily treatment of 40,000,000 gallons of water:—

| | |
|---|---|
| One extra operator | $0.065 |
| Bleaching powder | 0.065 |
| Coal for heating the plant, miscellaneous laboratory and other supplies | 0.010 |
| | $0.14 |

It may be well to point out that power costs nothing at this plant for the reason that it is obtained from a water wheel actuated by the water flowing through the pipes which deliver the water from the dam to the aqueduct leading to Jersey City.

With power costing nothing, the charge for electric current in this process is nil. It has been found that to produce a pound of available chlorine in the electrolytic cell requires about 8.5 pounds of common salt. This salt, delivered at the plant costs about one-third of a cent per pound; therefore, the cost for salt amounts to 4¼ cents per 1,000,000 gallons of water treated. The other figures previously given remain the same, making the total cost by the electrolytic process 11¾ cents per 1,000,000 gallons of water treated. In

neither case has interest on the investment been included nor charges for depreciation in the plant. If this were added the total cost of the process would be between 20 cents and 25 cents per 1,000,000 gallons of water treated.

As to depreciation in either process, it may be well to point out that, although the plant has now been in operation over seven months it has not been necessary to replace any of the piping, pumps or valves, and such repairs as have been made are not worthy of mention.

In general terms when hypochlorite of lime or soda is added to water the chemical and physical characteristics of the water are changed to some extent. Through the action of carbonic acid, either free or half bound, hypochlorous acid is released from the hypochlorite, and this acid, although very weak, is an active oxidizing agent. In the presence of organic matter its oxygen is released and this attacks the organic matter and oxidizes it. As hypochlorite of lime is a mixed compound, composed of calcium chloride and calcium hypochlorite, it follows that the former will add to the hardness of the water. In the electrolytic process where sodium hypochlorite is produced, the resultant solution contains in addition a slight amount of caustic soda and some sodium chloride, and the hardness of the water would, therefore, not be increased by its addition to it. In both cases the total solids in the water would be increased, and the color, if an organic stain, would be reduced. The carbonic acid in the water would be reduced, since it is essential for the liberation of hypochlorous acid from the hypochlorite.

In more concise terms it may be said that by adding hypochlorite of lime or soda to a water, the organic color thereof will be reduced; there will be an oxidation of organic matter; the carbonic acid will be reduced; the total solid matter in the water will be increased and, in the case of hypochlorite of lime, the total hardness of the water will be increased. With hypochlorite of soda this is not the case. All of the above changes were noted in a series of chemical analyses of the raw reservoir and treated waters. The amounts of chemical applied were so small, however, that the differences in the physical and chemical characteristics of the water before and after treatment were so slight as to be hardly noticeable and were well within the limits of accuracy of the methods of analysis.

The most important chemical change which is brought about in this process is the reduction of carbonic acid. This has considerable practical significance from a standpoint of the incrusting and corrosive action of water on iron and steel pipe brought about by the action of carbonic acid.

The claim has been made that free chlorine is liberated in this process, and that it may persist in water treated with hypochlorite of lime. This is in no sense true for the reason that free chlorine cannot be liberated from hypochlorite of lime or soda in a natural water. To do so it would first be necessary to decompose all the alkaline constituents in the water with an excess of strong mineral acid. Again, even if free chlorine could be liberated from hypochlorite of lime in a natural water, the chlorine would immediately combine with the hydrogen of the water and liberate atomic oxygen.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8053—Sept. 9—Authorizing the C. P. R. to construct, maintain and operate spur into the premises of the Brandon Gas & Coal Co.'s plant, Brandon, Man.

8054—Sept. 9—Authorizing the C.P.R. to construct, maintain and operate three industrial spurs for the Manitoba Rolling Mills, in the Town of St. Boniface, Man.

8055—September 13—Authorizing the Grand Trunk Railway to construct, maintain, and operate, branch line to and into the premises of Messrs. Davies & Doty, Oakville, Ont.

8056—July 13—Approving location of the C.N.O.R. Railway through Township of Gloucester, and the city of Ottawa, from mileage 53.91 to 57.42 west from Hawkesbury, Ont.

8057—September 13—Extending for period of two weeks from date of order time within which the C.N.Q. Railway may operate its trains from Quebec City or Garneau Junction.

8058—September 13—Authorizing the C.P.R. to construct, maintain, and operate branch line in the city Saskatoon, Sask., to a point to be determined by the city engineer.

8059—September 10th—Authorizing the C.P.R. to operate branch line to the premises of George Vrooman, Lethbridge, Alta.

8060 and 8061—September 10th—Granting leave to the Corporation of the village of Stirling, Ont., to place its electric wires across the track of the G.T.R. at Bake Street, Stirling, Ont., and at Edward Street, Stirling, Ont.

8062—September 10th—Granting leave to the Laval Electric Company to place its electric wires across the C.P.R. near Therese, P.Q.

8063 to 8065 Inc.—September 13th—Granting leave to the Bell Telephone Company to cross with its wires the tracks of the G.T.R. at Howick, P.Q., Stevensville Station, Ont., and Bridgeburg Station, Ont.

8066—September 14—Amending Order No. 7963, dated September 1st, 1909, authorizing the C.N.R. to alter its existing level crossing on Pembina Street, Winnipeg, Man., by substituting for the plans approved thereunder plans marked "A" on file with the Board.

8067—September 14—Authorizing the G.T.R. to construct, maintain, and operate spur into the premises of H. Corby Distillery Company, Limited, municipality of the Township of Thurlow, Ont.

8068—September 10th—Approving masonry work to be constructed at bridge No. 27.3, McLeod Section, C.P.R.

8069—September 10—Authorizing the C.P.R. to construct, maintain, and operate branch line in Blocks, 3, 7, 12 and 14, Plan Q, 10, town of Saskatoon, Sask.

8070—September 14—Approving and sanctioning location of the C.N.O.R. Company's Udney-Orillia line of railway through Township of Mara, County Ontario, Province Ontario.

8071—September 10—Granting leave to the Rural Municipality of Strathcona, to cross C.N.R. tracks one mile east of Belmont, Man.

8072—September 10—Granting leave to the Rural Municipality of Macdonald to cross with its wires the tracks of the C.N.R. at public crossing, two miles north-east of Brunkild, Man.

8073 and 8074—September 10—Granting leave to the Bell Telephone Company to cross the tracks of the M.C.R.R. near Bridgeburg, Ont., and near M.C.R.R. station at Welland, Ont.

8075 to 8078 Inc.—September 14—Authorizing the Volcanic Oil & Gas Company, Limited, to cross with its gas pipe under the track of the M.C.R.R. at four points in the Province of Ontario.

8079—September 14—Authorizing the G.T.R. to construct, maintain, and operate branch line in the town of Oakville, Ont.

8080—September 14—Authorizing the G.T.R. to construct, maintain, and operate branch line of railway and two spurs in the town of Orillia, Ont., to planing mills of J. R. Eaton & Sons.

8081—September 14—Authorizing the C.P.R. to open for the carriage of traffic that portion of the Nomining Extension of its railway from Nomining, mile 0 to Rapide de l'Orignal, mile 34.6, a distance of 34.6 miles.

8082—September 14—Approving Standard of Tariff of Parlor Car Rates C.R.C., No. S. 2 of the Esquimalt and Nanaimo Railway Company.

8083—September 14—Authorizing the C.P.R. to construct extra track of its railway across road allowance lying between Sections 14 and 23, Tp. 11, Range 12, west principal meridian, Province Manitoba.

(Continued on page 375.)

## IRRIGATION IN WESTERN CANADA.

### Splendid Work of C.P.R. in Alberta.

A development, which, owing to its magnitude, is absolutely unique in the engineering and agricultural annals of the continent, is that which is being so successfully brought to a completion in the Bow River Valley to the east of Calgary.

One requires but to realize the enormous value and possibilities of irrigation, to appreciate the inestimable wealth that will be acquired by those who till this fertile soil. The artificial application of water to the land not only increases crop production but also conserves the fertility of the soil to the greatest extent possible.

It is in the Bow River Valley that we find 3,000,000 acres of the choicest soil and ultimately 1,500,000 acres of this vast tract will be served by an irrigation system, which for its general utility and vastness will never be equalled on the continent.

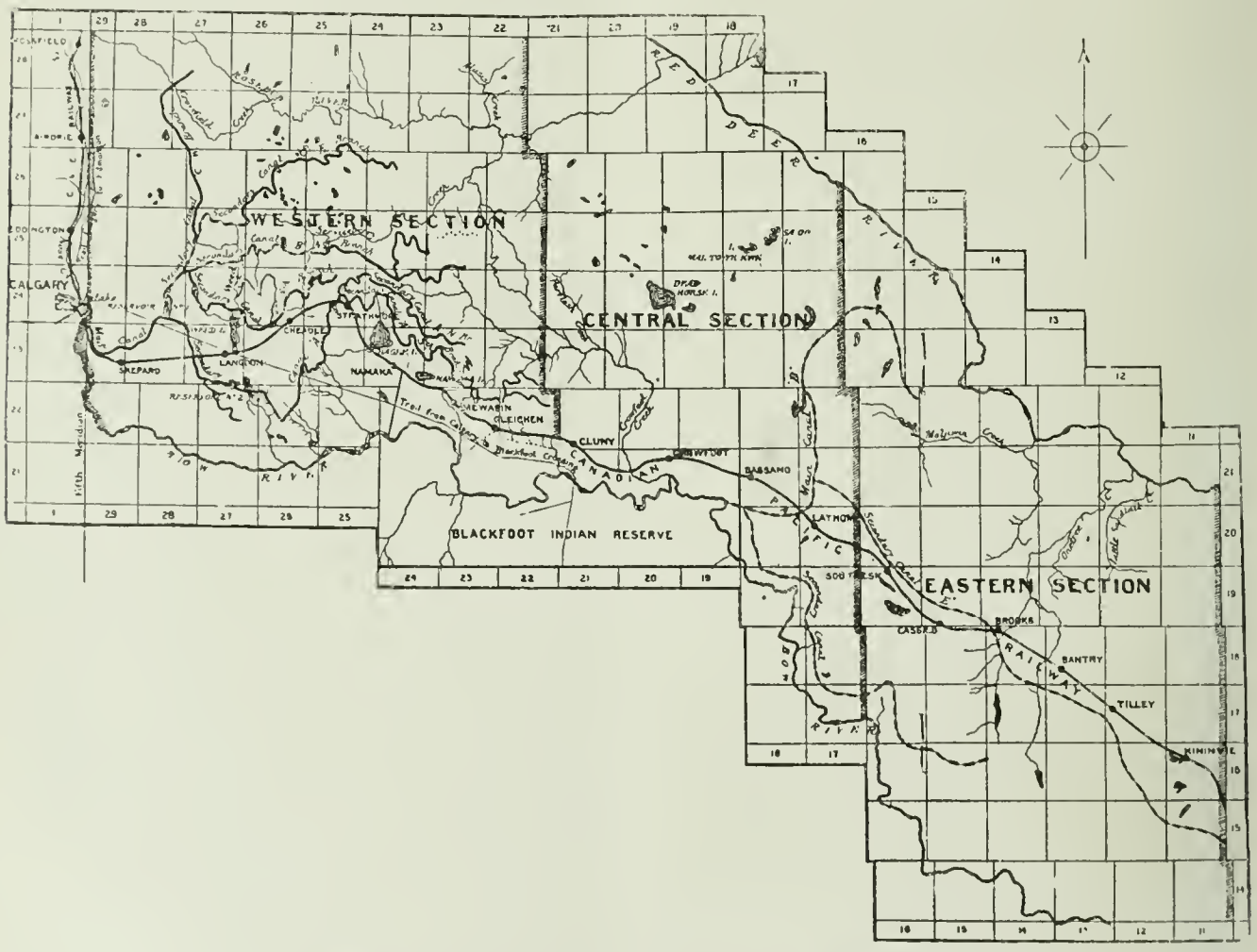
The company developing this area by a wise consideration of that which constitutes a profit, refuses to place upon this land a price anywhere approaching its intrinsic worth, being content rather to make a nominal charge per acre, being assured that to the east of that city they will create a giant consuming and producing area, which ere long will be the most densely populated farming district in the world. The traffic produced will be their reward.

Settlers are arriving in ever increasing numbers, and this year will find a multitude of converts to the irrigation system of farming.

We have been told that "he who makes two blades of grass grow where one grew before" is a benefactor of mankind. Without a too liberal application of this proverb, there can be no doubt that the Canadian Pacific Railway amply earned this title when that company decided to develop by irrigation the enormous block of land east of Calgary, Alberta.

The great project is 150 miles long by 40 miles in width and comprises an area of 3,000,000 acres of which at least 1,500,000 acres will be irrigated. In order to assist the engineers, the tract was divided into three sections, which were designated Western, Central and Eastern, each having an almost equal area. With a speed only made possible by a large and competent engineering staff these sections are being laid out in a system of ditches which when complete will comprise a length over 3,000 miles.

At Calgary is to be found the inlet of the main canal, the dimensions of the latter being at this point, bottom width 60 feet, width at water line 120; side slopes 3 to 1; depth of water 10 feet; sectional area 900 square feet. The grade is 0.528 feet per mile, and the completed discharge is over 2,000 cubic feet per second. This canal which is some seventeen miles in length terminates in a national reservoir three miles long, half a mile wide and 40 feet deep. From this basin the secondary canals A, B and C radiate, making the total length of main water channels 967 miles in the Western section. This is, of course, exclusive of the farmers laterals.




Map of Irrigation Sections of Alberta, on the C.P.R.

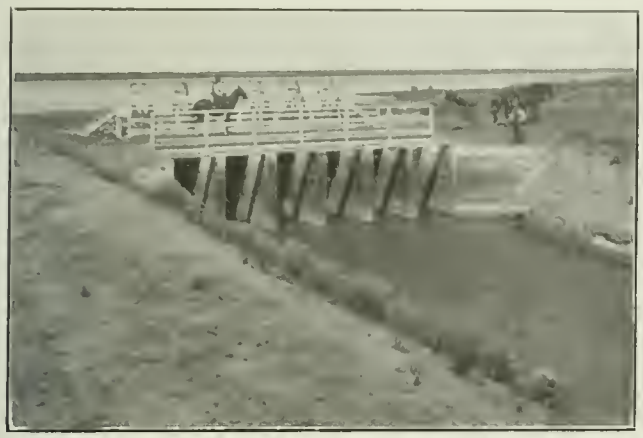
The construction of the canal in the Western section with its hundreds of miles of secondary canals and distributing ditches has been a large and expensive undertaking. The engineering surveys have been rigidly scientific and exhaustively performed, the contours of the entire Western section being located to five foot intervals.

An excavation of 2,500,000 cubic yards was necessary on the main canal while another 5,000,000 cubic yards were excavated in order to make the secondary canals A, B and C.

Many difficulties were experienced in the construction of the main canal and close to the headgates an unusual feature presented itself. It would have been necessary, if the canal line were to be kept on grade, to have thrown it on to

a bluff bordering the bottom. The incline of the bluff was much steeper, however, than the slope of the canal and it was decided that rather than make a cutting reaching entirely to the top, it would be much better to allow this bluff to form one side of the canal and form the other by means of an embankment.

The level of the old river bottom is that which was used in a portion of the work as the bottom for the canal and at the end immediately next to where excavation was again resumed the depth of water carried is twenty six feet. Where the excavation commenced the grade line was again resumed.



**Headgates Secondary Canal Leading from Reservoir.**

In the building of this embankment, the greatest care was exercised. Stripping was resorted to in dealing with the surface soil and more of same was allowed to be used. In order that the embankment should he of a maximum strength, successive layers of selected material 10 inches in depth was all that was allowed to be dealt with at one time. This material was evenly distributed over the surface, given an application of water and thoroughly rolled with a three-ton roller.

Owing to the natural slope of the country it was necessary to construct falls or "drops" which carry the water safely to the levels below, without erosion of sides or bed. Along the river's bank and in close proximity to the inlet, piles have been driven with a view to protecting the banks, and situated along the embankment is a spillway which allows only the required amount of water being retained.

**Headgates of the Main Canal.**

It will be seen by the above that every precaution has been taken in order that the canals and laterals may be protected to the greatest possible extent, no expense in the construction of same having been spared.

It is with pride that any country points to the work of their civil engineers, works which in the majority of cases are great constructive works of peace. Canada is no exception, her engineers are without peer, and it is to their indomitable pluck and perseverance that we owe our very existence. It would appear that the average individual does not appreciate what a factor the civil engineer is in the upbuilding of a country or community.

When the irrigation of the Bow River Valley was first proposed, a veritable storm of ridicule was directed at those who were courageous enough to conceive and advocate the scheme. That ridicule continued even after actual operations were commenced. Now, however, we find an appreciative feeling existing throughout the West and in Calgary especially there is an ever increasing interest manifested by the prominent citizens who have at last awakened to the fact that with relentless and never-ceasing vigor, the Canadian Pacific is working out the destiny of Calgary, and that destiny is a metropolis of wondrous magnitude. Have the Canadian Pacific failed in any of their ventures? Have they not built cities where they wished them, and have they ever sanctioned any other expenditure for agricultural development, anywhere approaching that being expended on the Bow River project?

**Two Miles Below Headgates Looking East.—Showing Pole Line and Rip Rap.**

All this is due to the untiring perseverance of those who first considered the scheme possible.

This most successful engineering effort is unique in the fact that it is a great creative factor in the making of a demand for labor. As science advances, channels which were at one time open for individual effort are closed and the demand for labor decreased. By the opening of each fresh channel in the Bow River Valley, however, we find there an immediate demand for labor and an immediate possibility of happy, prosperous home.

## RAILWAY ORDERS.

8084—September 14—Authorizing the City of Toronto to construct an additional bridge across the tracks of the G.T.R. and the C.P.R. where the same crosses Dundas Street, Toronto, Ontario.

8085—September 15—Granting leave to the Winnipeg Electric Company to operate their cars and trains over the track of the C.P.R. Company on Logan Avenue, Winnipeg, Man.

8086—September 15—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its tracks the tracks of the C.P.R. at Yonge Street, Fort William, Ont.

8087—September 15—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its tracks the tracks of the C.N.R., Fort William, Ont. (at Yonge Street).

8088—September 14th.—Dismissing application of the corporation of the town of Leamington, Ont., to open up and construct a street over the right of way of the Leamington and St. Clair branch of the M.C.R.R. in the said town.

8089—September 15—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its tracks the track of the G.T.P. Railway, at Yonge Street, Fort William, Ont.

8090—September 13—Granting leave to the corporation of the town of Listowel, Ont., to place certain wires across the track of the C.P.R. at Main Street in said town.

8091—September 14th—Granting leave to the village of Stirling, Ont., to place certain electric light wires across the track of the G.T.R. at William Street in said village.

8092 September 14—Granting leave to the corporation of the town of Listowel, to place certain electric power wires across the track of the C.P.R. at Inkerman Street in said town.

(Continued on page 383.)

## DISCUSSION OF TRACK ELEVATION IN CHICAGO, ILLINOIS.*

M. K. Trumbull, Engineer of Track Elevation.

The City of Chicago has maintained a track elevation policy for almost one-fourth of its corporate existence. The annual growth of track elevation has been consistent. The cumulative result is remarkable. The railroads have executed mile after mile of this kind of construction with scarcely a word from public or press. Scarcely a train has been delayed. How few know even the names of the men who design and execute the work and in whose care the public safety is placed. How vigilant and resourceful they must be is little appreciated by the passengers who are almost lifted while they ride.

To elevate a stretch of railroad is no simple task. Wherein lies the factor that transforms what would seem an ordinary piece of construction to one that is difficult? Traffic. Every large merchant who completely remodels his store and takes care of his customers simultaneously can have some idea of what track elevation means to the railroad man. Every manufacturer who rebuilds his plant while continuing his operations; every restaurateur, or hotel keeper, who does likewise can gain some notion of the engineers' achievement; but none can conceive of the difficulties incident to the protection of life and comfort not only of passengers riding on the trains but of those making up the flow of travel at street intersections.

With a congested right of way to begin with the railroad must rebuild from below the ground up and handle its traffic without delay at the same time. The Commissioner of Public Works permits the blocking of but three or four consecutive streets at any one time. Two miles of track elevation, for instance, must be divided into from four to five separate sections in each of which the operations are separate and distinct. The object of this programme is to offer the minimum of obstruction to street travel; especially to surface cars and the city fire department. This restriction upon the railroads increases the cost of the work, complicates the handling of trains and lengthens the time to complete the work. Even this programme cannot wholly eliminate the damming up of the arteries of travel contiguous to the particular section in which the heavy operations are being carried on nor the temporary suspension of normal business on the part of a few tradesmen who happen to be located immediately adjacent to the railroad tracks that are being elevated.

The engineer must carefully map out his programme for the season and follow this schedule with a daily "line-up" which has in view the logical sequence of each distinct operation. The nature of the work requires that heavy operations and large forces of men must be handled within limited areas. The time interval between each two operations must be calculated to a nicety. Upon consideration of the many complications involved one wonders at the dispatch with which the work is accomplished.

Track elevation, properly speaking, began on May 23, 1892, when the Illinois Central Railroad Company secured from the City Council an ordinance for the elevation of its tracks from 51st street to 67th street. An urgent necessity confronted the Illinois Central officials to make some quick and radical moves in order to place themselves in a position to handle the heavy passenger traffic to accompany the opening of the World's Fair the following season. Thus a creature of necessity, track elevation, had its birth. The population of Chicago at that time was 1,200,000. A crying need for a relief at a great number of grade crossings, where the railroads were annually killing and injuring many people, was felt. A few cases had been disposed of at important streets, by constructing viaducts over the tracks, to accommodate the street travel. The viaducts policy had, however, become unpopular. The height at which it was necessary to erect the viaducts, above the original grade of streets, required the construction of long approaches, not only in the streets provided with viaducts, but in those that intersected the site of the approaches as well. Then, as necessity arose, nearby streets were selected for viaducts. The logical result threatened that the zones of city property contiguous to the railroads was soon to be enmeshed in a network of approaches which would not only offer long and heavy grades to street traffic but would considerably depreciate the value of the property affected.

The track elevation idea was eagerly grasped by the city administration. Press and public alike demanded that all of the railroads within the city limits should forthwith proceed to elevate their tracks. Responsive to this demand, but with profound deliberation as to the feasibility of the programme, the City Council, within nine months after the passage of the Illnois Central ordinance, on February 23, 1893, passed a General Ordinance which provided for the elimination of all grade crossings in the city by track elevation. This ordinance was too comprehensive.

The railroads declined to enter into the wholesale scheme of construction expense. The administration thereupon made a survey of those zones in which the street crossing travel was most dense and decided to treat each zone separately, and where necessary, to further sub-divide each into elements of reasonable length.

Proceeding upon this theory the City Council, on July 9, 1894, passed an ordinance for the elevation of the tracks of the Chicago, Rock Island and Pacific Railway from Archer avenue to West 69th street and the tracks of the Lake Shore and Michigan Southern Railway from Archer avenue to State street. Less than seventeen months had elapsed after the passage of the General Ordinance. In this short period the Council found that it had started on the wrong track, took its bearings, and threw the helm to another course. Fair sailing was soon encountered and the good ship has not swerved since.

During the following four years seven separate pieces of track elevation were proivded for. This meant continuous labor on the part of the city administration and the railroads.

The first appropriation for the department was embodied in the budget for the year 1898.

Former Alderman Walter J. Raymer, was tendered the office as Mr. O'Neill's successor. This was a promotion from the Purchasing Department, in which he had served with distinction as its head.

Forty-two separate or original ordinances listed on pages 24 to 28, have been passed in the last seventeen years, or an average of about two and one-half per annum. With this period as a perspective, a glance at the first plat above referred to is of interest.

By the provisions of the General Ordinance the city was divided into three districts which are shown on Plates I and II. All tracks within District I. were to have been elevated by January 1, 1895; all tracks within District II. by January 1, 1897; and all tracks within District III. by January 1, 1899. Thus the railroads were required, by this ordinance, to elevate all their tracks within a period of six years. During the seventeen years that have elapsed since its passage the population of Chicago has been increased 85 per cent., until to-day the city numbers 2,200,000 inhabitants. Not much work has been done in District I. There has, in fact, been little necessity or demand for track elevation within this area. Nearly all the tracks in District II. have either been elevated or track elevation has been provided for. District III. offers much for a healthy growth of track elevation relief for the grade crossing evil.

Seventy-four per cent. of the work, for which ordinances have been passed, has been completed. The 148.72 miles of railroad roadbed, already covered by track elevation ordinances, is approximately 44 per cent. of the total mileage of roadbed within the city limits. Basing an estimate on this percentage and assuming:

*Abbreviated from a report to Walter J. Raymer, Commissioner of Track Elevation, Chicago, Ill.

First—That the city limits remain as they are at present;

Second—That the growth of population will require all tracks to be elevated within these limits;

Third—That the cost per mile of roadbed will be 80 per cent. of that already provided for, on the theory that there will be fewer tracks per mile of roadbed;

The ultimate cost of track elevation will approximate $150,000,000. This estimate, however, looks so far into the future that any one or more of these assumptions may be found to be without foundation.

The 720 subways, averaging seven subways to the mile of roadbed elevated, may be classified as follows: Roadway grade crossings abolished and subways provided for; viaducts removed and subways provided for; foot passageway subways; alley subways; railroad grade crossings separated; subways constructed by private contract, considering as a single subway each case where two or more roads have elevated their adjacent roadbeds and have participated in the expense of constructing the joint subway.

There is a mistaken impression in certain quarters, that it takes the railroads an unreasonable length of time, after the Track Elevation Department has opened negotiations for the elevation of any particular stretch of their tracks, to seriously discuss the question. On the contrary, the attitude of the railroads has been natural. In some cases, it is true, negotiations between the city and the railroad officers have consumed much time; but the average period has been short. The situation is parallel with negotiations preliminary to contracts of any character. As soon as the ordinances have been passed, approved and accepted, the railroads have executed their part of the agreements in good faith. In numerous cases they have even gone further and have performed work not called for in the ordinances, either upon their own initiative or upon the request of the city officials. This has brought about better feeling between the city and the railroads then existed a decade or two ago.

The officers of the railroads take personal interest in their work, with the result that the appearance and efficiency of their designs are steadily improving. Their efforts are inspired by the desire to produce permanent structures upon which the annual maintenance cost will be low. The city is beneficiary in that the more recent subways are more nearly watertight and noiseless than formerly. Seepage of moisture through abutments and retaining walls is prevented, greatly improving the appearance of the masonry. Shallow metal decked floor systems with their sounding board effect and lack of resistance to the dropping of water into subways below are a thing of the past. Be it said, however, that the railroads made their designs, ten or twelve years ago, in the light of what was then deemed best. To-day shows the result of study and a desire to improve. Track elevation has thus been an evolution.

The benefits from track elevation are so many that it is difficult to describe them briefly. First and foremost is the manifest reduction in grade crossing fatalities and injuries. Table I. speaks for itself, and no amount of comment on the writer's part can add any weight to it. No words can be more convincing when arguing in favor of track elevation.

This record takes no account of the accidents which occurred on the railroad rights of way between streets. It is a grade crossing record only. Prior to 1899 thirty-five miles of railroad roadbed had been elevated and one hundred and thirty-five subways had been constructed. This work, comprising about 30 per cent. of what has been completed to date, saved many lives and many accidents.

An estimate based on the data in Table I. would indicate that track elevation has prevented to date about 1,380 grade crossing fatalities and about 2,510 non-fatal accidents. How many more it has prevented between streets would be difficult to determine. There is now little temptation for boys to "hitch" and for other trespassers to climb upon the railroad tracks which are elevated.

On the basis of the $53,622,000 already spent, each grade crossing accident, prevented to date, has been effected at an expense of $13,800.

The outlay for track elevation, spread over a period of years in the future shows a material reduction for each estimated accident prevented, such that the $13,800 will become less than $3,000 within two generations on the basis of a total expenditure of $150,000,000.

Material results, however, should not be lost sight of Consider the time that would be lost annually in case no tracks had been elevated. During the year 1908 there were recorded 643,386,000 rides on the surface lines alone. Most of the railroads intersect street car tracks every half mile where the city is built up and where surface traffic is heaviest. It is fair to assume that 150,000,000 of these rides encountered railroad tracks or subways. If track elevation had not been accomplished passengers would have suffered many delays, due to crossings being blocked. Assuming that each passenger trip of the 150,000,000 would have been delayed an average of one minute and that 90,000,000 pedestrian trips would have been obstructed a like amount, 4,000,000 hours time would have been lost. The street cars themselves would show decreased operating revenue. When the delay to teams, carriages, and automobiles is considered a conservative estimate of the value of time lost would approximate $1,500,000 per annum.

If the above reasoning is correct, track elevation conserved this amount of wealth during 1908. Year by year the amount will be increased in direct ratio to the traffic affected. For illustration, and illustration only, if the population of Chicago could be taxed annually the amount thus conserved, the limit of bonded indebtedness of the city could be safely

**TABLE NO. I.**

ANALYSIS OF DECREASE IN GRADE CROSSING ACCIDENTS.

| | | Deaths All Causes | | GRADE CROSSING ACCIDENTS. Fatal | | | Non-Fatal | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Population | Number | Rate Per 1,000 | No. | Rate Per 1,000,000 | Percentages of Death All Causes | Number | Rate Per 1,000,000 | Number | Rate Per 1,000,000 |
| 1899 | 1,626,333 | 25,503 | 15.7 | 113 | 69 | 0.44 | 169 | 104 | 282 | 173 |
| 1900 | 1,698,575 | 24,941 | 14.7 | 97 | 57 | 0.39 | 105 | 62 | 202 | 119 |
| 1901 | 1,757,010 | 24,406 | 13.9 | 64 | 36 | 0.26 | 91 | 52 | 155 | 88 |
| 1902 | 1,815,445 | 26,455 | 14.6 | 61 | 34 | 0.23 | 122 | 67 | 183 | 101 |
| 1903 | 1,873,880 | 28,914 | 15.4 | 69 | 37 | 0.24 | 169 | 90 | 238 | 127 |
| 1904 | 1,932,315 | 26,311 | 13.6 | 55 | 29 | 0.21 | 172 | 89 | 227 | 118 |
| 1905 | 1,990,750 | 27,212 | 13.7 | 99 | 50 | 0.36 | 48 | 24 | 147 | 74 |
| 1906 | 2,049,185 | 29,048 | 14.2 | 68 | 33 | 0.23 | 65 | 32 | 133 | 65 |
| 1907 | 2,107,620 | 32,143 | 15.2 | 38 | 18 | 0.12 | 62 | 29 | 100 | 47 |
| 1908 | 2,166,055 | 30,548 | 14.1 | 20 | 9 | 0.07 | 27 | 12 | 47 | 21 |
| | Average 10 Years | | 14.5 | | 37 | .026 | | 56 | | 93 |

more than doubled (from about $23,000,000 which it is at present).

The reduction in annual fire losses due to track elevation is difficult to compute. Be it said, however, that the delay to the fire department in reaching conflagrations is enormous when the railroad crossing gates are closed for passenger or freight trains. Every moment elapsing between the time a fire starts and the arrival of the fire department at the site is vital and is a matter of important consideration when viewing the delay due to a blockade at one or more railroad crossings.

Some additional benefits due to track elevation, obviously only a brief survey of the situation, are here enumerated:—

1. New districts are opened for settlement, thus reducing local congestion in population.

2. Accessibility to churches, markets and schools is improved.

3. Courts have fewer cases due to trespass, "hitching," or car thieving, etc.

4. Few streets are now crossed by railroad yards. Twenty-one yards have been elevated to date.

5. Better time is made by trains; fewer accidents occur for which the public has to suffer and for which the railroads have to pay; railroad rights of way are more clearly defined; freight trains do not have to be cut at street intersections.

6. Underground pipes and conduits are more accessible in subways than when lying directly under the tracks where the latter have not been elevated. Breakages of pipes and conduits due to the impact of heavy track loads are eliminated.

7. Improvements, such as new station buildings, new team yards, new freight houses, etc., are secured. In fact, within the limits of track elevation, the railroads are entirely rebuilt and reconstucted along strictly modern lines.

8. Future electrification of the railroads is made easier in that the third rail and return circuits can be more easily disposed of. This, however, is only one of the many difficulties attending the consideration of the question of electrification.

9. Nine unsightly viaducts have been removed. An additional viaduct will be removed this year. Only three away from the river will remain after this year.

10. Seven railroad grade crossings have been separated. One more has been temporarily separated. Three additional cases will be disposed of under existing ordinances with the probability that two more will be agreed upon by the railroads before all the ordinances now in effect have been executed.

Track elevation results have been tabulated above. The benefits have just been outlined. Let us see how much has been drawn from the City Treasury to help pay for this $72,622,000 improvement that the railroads have made.

The diversity of design as to retaining walls and abutments, both for foundation and masonry above foundations, is almost as great as in the superstructures. In the early years of track elevation the use of cut stone and rubble masonry was general, but to-doy concrete is used exclusively. During the last five years walls and abutments have been constructed of reinforced concrete by some of the roads.

The soil in and about Chicago is not the best for foundations. Few of the roads place the bottom of foundation more than one foot below the frost line. Two companies use caissons for column foundations. Of those companies constructing foundations only a trifle below frost line some drive piling under the toes of the retaining walls and abutments. Others extend the toe to add greater resistance to overturning. The soil is soft and some settlement results except in the case where caissons are sunk to bed rock. Concrete walls above foundation are constructed with "battered" or "stepped" back, according to preference of the engineers.

An earnest effort is being made to prevent the percolation of water through the walls and abutments. This improves the appearance and lengthens the life of the concrete. Some roads coat the back with asphalt or pitch. Some employ longitudinal drainage either four or five feet below the elevated track level or at the original grade of the tracks. Some use "weep" holes through the walls.

The writer will not attempt to go into discussion of the methods pursued by the different companies in elevating their tracks, unit costs, etc. Such a subject is interesting but would probably be out of place in this brief discussion. Suffice it to say, that, whereas, in the early years practically all work was done by hand, to-day nearly all classes of heavy work are performed by machinery. By the latter method smaller forces can be employed eliminating delays and uncertainty due to labor troubles. The rate of progress is thereby accelerated and a more uniform daily output assured. Even with the use of machinery track elevation gives employment to about five thousand men annually in Chicago.

Taken as a whole, Chicago track elevation as it appears to-day is a most satisfactory public improvement. There are a few places where reconstruction will be necessary in the

**TABLE No. 2.**

COST OF TRACK ELEVATION TO THE CITY OF CHICAGO.

Note—Percentages shown are on basis of cost to the Railroads ($72,662,000.)

| | | | | |
|---|---|---|---|---|
| Department Expenses to date | $ | $ 66,084.29 | $ | 0.09% |
| Damages paid to date: | | | | |
| At 10 Streets where Viaducts were removed | 256,151.01 | | | |
| At 700 " " no " existed | 105,107.75 | 361,258.76 | | 0.50% |
| Total paid out of City Treasury to date | | $ 427,343.05 | | 0.59% |
| Paid into City Treasury Account Track Elevation | | 280,000.00 | | 0.39% |
| Net Cost to City to date | | | 147,343.05 | 0.20% |
| Estimated Damages yet to be paid on account Track Elevation Ordinances to date | | 350,000.00 | | 0.48% |
| Plus above | | 361,258.76 | | |
| Total estimated to be paid out of City Treasury for damages account Track Elevation Ordinances to date | | $ 711,258.76 | | 0.98% |
| Plus above | | 66,084.29 | | |
| Total estimated to be paid out of City Treasury including Department Expenses Account Track Elevation Ordinances to date | | $ 777,343.05 | | 1.07% |
| Less above | | 280,000.00 | | |
| Net estimated cost to City Account Track Elevation Ordinances to date | | | 497,343.05 | 0.68% |

near future. There are subways which are poorly drained due to the inadequacy of the existing sewers. The latter, however, is a general evil which is not confined to the areas in which railroad tracks are located. It has been brought about by—

First—The flat and low grade of the city itself.

Second—The phenomenally rapid growth of the city.

Third—The hand-to-mouth scheme on which the city finances have been run due to the low limit of bonded indebtedness. This means that the design of sewage and water systems could not sufficiently anticipate the future demand.

A number of subways have been depressed so far below the original elevation of the streets that the roadway grade is down dangerously close to the sewer tops. That this condition is undesirable is obvious. A number of subways on the West and North sides, having surface cars, were provided with only twelve feet six inches of headroom in the original ordinances. The large type of cars provided for in the "Traction Ordinances" requires thirteen feet and six inches of headroom. How to secure the additional twelve inches without further depressing the floors of the subways or without necessitating a further elevation of the railroad tracks has been a problem. The railroads had completed their track elevation, under their contract ordinances, and were subject to no further demands. On the south side fortunately the City Railway Company looked sufficiently far into the future and demanded thirteen feet and six inches from the beginning of track elevation.

At subways under construction where sufficient headroom was not provided in the ordinance, the track elevation department has successfully urged the railroads to provide the additional amount. This correction of the old ordinances is progressing in such manner that as the rehabilitation of the surface lines is effected, and the through routes are inaugurated, no obstruction is met in carrying out the programme on account of insufficient headroom in subways.

The policy of the present administration has been, and is, to provide thirteen feet and six inches of headroom at all streets where surface lines exist, or are probable, and twelve feet at all others. A smaller amount of depression of the streets is being allowed the railroads. Subways are to be provided at least eight for each mile of elevation. A more careful consideration of all the many factors is being made than heretofore.

## PATENTS.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 103 Bay St., Toronto: Pollock Manufacturing Co., tone arm for talking mahines; R. H. Trumpour, clocks; Wm. S. Simpson, uniting, joining or welding of metals by fusion; Wm. S. Simpson, uniting or welding of metals; Pearce & Billington, typographical composing machines; Bevan & Morley, Nutlocks; J. C. Barker, automobile tires; F. W. Leever, stop and through way valves.

At Boat Harbour, Vancouver Island, between Nanaimo and Ladysmith, some thirty miles from Vancouver, the Pacific Coast Coal Mines, Limited, has recently opened up a new coaling port, capable of accommodating large ocean-going vessels. The bunkers are large, and the loading equipment has a capacity of 750 tons per hour. The collieries are distant seven miles from the harbor, and railway connection and modern rolling stock are already provided. The Company owns 200 acres, and has rights over 5,000 acres in addition. A large amount of tunnelling has been done and production has commenced. The seam at present worked is reported to be from 5 feet to 20 feet in thickness. Other underlying seams have been encountered in diamond drilling.

## THE PHENOMENA OF RESONANCE IN ELECTRIC LINES.*

By J. Dalemont, E. E., M. Sc.

The phenomena of resonance may produce in electric circuits, as it is well known, some very serious accidents, such as the breaking of the cable insulation, sudden rise of tension or intensity, etc.

For example, the accident which happened in the underground light and power circuits of Berlin (Germany).

In this instance, the voltage of the busbars suddenly reached a value higher than the normal, the intensity of the current doubled, and the frequency was three times the normal; all this, without any higher admission of steam in the steam engines working the alternators.

This has often been attributed to the effect of resonance. We know that in a given circuit, the resonance proper depends on the self induction of the lines, on the machines, and also on the capacity of the lines.

But these values vary with the load of the circuit. In the present case, when the conditions for the resonance of the third harmonic were fulfilled, the amplitude of this harmonic increased rapidly.

To reduce the busbar tension to its normal value, the engineer of the power-house diminished the excitation current and thus, the amplitude of the third harmonic assumed a marked influence, and took the place of the fundamental wave.

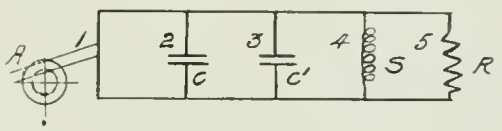



**Fig. 1.—Fictive Circuit replacing the actual distributing Circuit.**

In Berlin a recurrence of the accident was avoided by placing resistance coils in the circuits of the alternators. The impedance of these coils was sufficient to eliminate the currents of higher frequency. The foregoing shows the disadvantage arising from alternators having a low tension drop obtained through a low self-induction.

The tendency however, to-day, is to reduce the total reaction of the machines leaving a high value to the self-induction proper of the armature circuits. The self-induction of working alternators comes into the formula expressing the frequency proper of the circuits.

$O E_o$ : elm. force at no load
$V$ = tension at the terminals.
$E_o e'$ = opposite reaction.
$e' e''$ = cross reaction.
$e'' e'''$ = elm. force of self-induction.
$e''' V$ = ohmic drop.

Let us consider an alternator A which supplies a circuit having self-induction and capacity. Let E be the constant e. m. f. at no load of the alternator;

V, the tension at the busbars;

l, the self-induction of the alternator;

C, the capacity of the receiving and cable circuit;

*In a technological and scientific dictionary, edited by G. F. Goodchild, B.Sc. (London) and C. F. Tweney, the following definition is given of the word Resonance: "If any body be acted upon by a succession of impulses or vibrations, which recur at intervals corresponding to its own natural period of vibration, it will itself be caused to vibrate. The phenomenon is very easily observed in the case of sound. e. g., a stretched string is readily set in vibration if a note of the same pitch (frequency) as its own fundamental tone be sounded in the vicinity."

Webster says: "By extension, the increase of vibration of any kind, as in electricity, by an intermittent force of the same period. In electricity, the principle is valuable in detecting and investigating electro-magnetic waves."

l', the self-induction of same;

r, the resistance of same;

p, the pulsation of the fundamental wave of tension and current.

We can use a fictive circuit (fig. 1) instead of the actual circuit, and assume: 1st: the capacity of the receiving circuit is divided in two capacities c' and c", one of which, c" gives the resonance with the self-induction l of the alternator, while the other, c' gives that of the self-induction S of the receiving circuit and of the lines.

2nd: the self-induction and ohmic resistance of the receiving circuit and of the lines, are separated in two circuits, R and S, one having the ohmic resistance R, the other the self-induction S. Then, if the resonance is reached between 1—2 and 3—4 the current $I_1$ supplied by the alternator A will be the resultant of the currents $I_2$ and $I_5$, making an angle of 90 degrees. The tension V at the terminals, of the alternator, will be in phase with $I_5$.

Fig. 2 shows the vector diagram of the currents and the tensions; O $E_0$ is the elm force at no load; O e" the the elm. force produced at the resonance load in the armature by the flux resulting from the normal excitation and the armature current; oi and oi' are the two components of the current $I_1$, one of which is in phase, the other in lag of 90 degrees with the elm. force at no load. These compon-

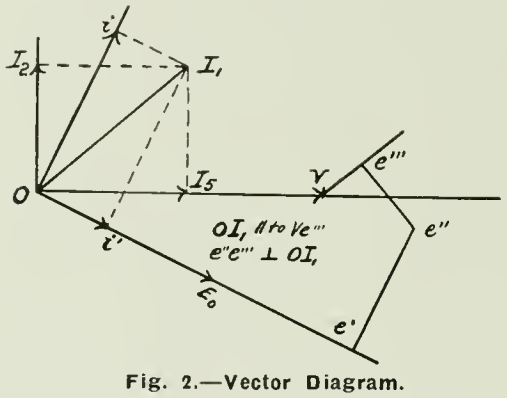



**Fig. 2.—Vector Diagram.**

ents produce in the armature the opposite and cross reaction. We can see that V is much greater than $E_0$. The resonance phenomena take place in the circuit 3 — 4 when

$$p\,l' = \frac{1}{p\,c'}$$

and likewise in circuit 1 — 2, when

$$p\,l = \frac{1}{p\,c''}$$

and since from $c' + c'' = c$, we obtain

$$p^2 c = \frac{l + l'}{l\,l'}$$

If we substitute $\frac{l\,l'}{l + l'} = L$ the condition of the resonance will be then:—

$$p^2\,c\,l = 1$$

As we said above, the dangerous effects of resonance are not to be feared for normal frequency, that is for the fundamental wave, but the higher harmonics may produce this resonance with harmful result.

In a circuit supplied with alternating current at 60 cycles, the frequency of the 5th harmonic is 5 x 6. 28 x 60 = 1885 and in this case in order that the 5th harmonic give the resonance, we must have

$$c\,l = .28210^{6}.$$

From $L = \frac{l\,l'}{l + l'}$ we can see that the influence on L of an increase of the alternator's self-induction is not very great, but it might be sufficient to eliminate the currents of higher frequency. The advantage of using compound alternators is also shown by fig. 1; the component of the current in lag of 90 degrees with $E_0$ is ahead of the no-load elm. force. The result is that it has a magnetizing effect on the armature circuits. If the armature reactions were compensated as happens in the compound generators, there need be no fear of the magnetizing effect of the armature current. On the other hand, it has been often shown that the construction of compound alternators with a higher self-induction and armature reaction would be more economical than that of the machines built at the present time for a low tension drop.*

It is difficult to see where improvements with regard to reducing the size and cost of alternator for a given output can be made, for although many attempts have been made to get a satisfactory compounding device, none of these have been very successful up to the present time. One of the reasons is that most of these devices have been fitted to the exciter with the result that to the field excitation lagged behind the change of load. It is therefore probable that compounding devices which are not directly applied to the alternator will never be entirely successful.

The higher harmonics of the tension may produce the breaking of cable insulation, and its effects are the more to be feared because the resonance of these harmonies, that is to say, the increase of its amplitude, is not generally shown at the voltmeters and other apparatus.

The engineers at the power-house could, therefore, not be warned of this increase of the tension, except by the breaking of the cable insulation in the circuit.

The importance of these facts is easy to see, especially if we consider that the resonance of the lower harmonics depends on the values of the self-induction and capacity of the circuits, increasing with the development of lines and underground cables.

From this point of view, the test of cables at a higher tension than the distributing tension is not sufficient, because a dielectrikum does not resist so well at high frequency as at low frequency.

Accidents of resonance may be avoided by the use of high self-induction alternators giving a sine curve elm. force. However, the use of such alternators may not be sufficient, because in many cases the generators are not connected directly with the distributing lines. The transformers placed in the circuits to increase or reduce the tension at the generating or receiving end, can, as shown long ago by Rowland, alter the wave by the variation of the permeability with the induction. The dangers of resonance may still continue, but we may add, that the low induction generally admitted by the transformer cores will not cause any great change in the wave of the elm. force.

To avoid accidents through resonance in underground circuits, it becomes necessary to take the tension curves at the power station with an oscillograph. In this way it may be easily ascertained whether the harmonics are present or if their amplitudes do not reach an excessive value.

It may, however, also be necessary to take tension oscillograms of the motors supplied by the circuits because the resonance of their own harmonics may be produced by the self-induction and capacity of a local circuit in which currents of high intensity would be produced.

*On this question we could mention an interesting work of McFarlane and Barge, recently published in the "Electrician" (11 and 18, of December, 1908.)

The statement was made in Wall street recently that Harriman pacific roads have now under construction 2,000 miles of extensions, with expenditures approximating $100,000,000.

According to the latest statistics the total peat-bogs of Sweden would be capable of producing 10,000 millions of tons of air-dried peat, suitable for fuel. This quantity, as compared with the present import of coal, would be sufficient for a period of 1,500 years. More exact examinations of the geological character of the peat-bogs will soon be started by the Swedish Geological Society.

## TREES, FENCES AND HEDGEROWS.*

By Harold Parker, M. Am. Soc. C.E., Chairman Massachusetts Highway Commission.

In discussing the questions which are indicated in the title of this paper, it should be borne in mind that two causes for the results that have followed man's effort to beautify and improve what was first done from necessity alone must be taken into consideration, in order to bring before you the conclusion which I desire to make plain.

In the first place, before we can take into account the roadside trees, hedge rows and fences, we must consider that the road itself was the first development of the necessities of man. He had to have a road which led from one point to another, not only for his own passage, but for that of the vehicle which carried his produce, or later contributed to his pleasure; so that in the laying out of highways, as means of transportation alone, neither the comfort of those using them nor the beauty of their surroundings was considered, the aim of the road-builders being to secure the easiest means of getting from place to place.

It is not supposed to be a part of this discussion that I should consider the location, construction or maintenance of roadways, except in so far as the trees and roadside growths may be either a protection to the road itself or contribute to the comfort and happiness of those passing over it, which is, to be sure, a question of some economic advantage, and therefore has a value beyond the purely aesthetic.

Roads themselves have grown with the growth and wealth of population, and have usually kept pace with such growth, and, as the leisure and financial ability of communities increased, as well as the opportunities for improving their roadsides, the improvement of the roads and the beautification of the roadside surroundings became a sought-for consummation, and, as civilization increased, a practical interest.

In this way it may readily be seen that where population has concentrated for economic reasons, there has gradually grown up the desire for aesthetic effects, as is shown in the creation of parks and public reservations for the enjoyment of the people at large.

For the same reason the ornamentation of roadsides, extending gradually into the country from larger cities and towns, has developed and grown with the wealth of the people themselves; so that, as we look at it now in America, one of the considerations that are brought prominently to our attention, after building the best road that we know how, is the planting of roadside trees and other ornamental growths, and the erection of walls and fences that are no longer unsightly, but which will contribute to the beauty of the landscape and the unconscious advantage of those travelling over the road. This has now become so universally accepted that it cannot be ignored, even if those persons who are wholly practical consider it an unnecessary expenditure of money.

The development of this aspect has, of course, been different in Europe than in America, for there it has been so long and so gradual in its advance that it has attained in most of the civilized countries of Europe a finished result. There the roadside trees have been under intelligent care for generations, and produce on the mind of the traveller the most pleasing and salutary effect, even to those so ignorant that they cannot appreciate the reason therefor.

In France, and other parts of the continent of Europe, like the people themselves, the results have been largely of a formal or artificial character. In England, nature has been followed more closely, so that you get two methods of beautifying public reservations and the space between the travelled way and the fields of abutting land owners, which have grown by degrees from primitive conditions to the present artistic state.

In America, we have the advantage of both these methods worked out for our consideration, on which we can improve, but which do not give us immediately the results of trees of great size, or the finished appearance which comes through time alone.

To those of you who have driven horses or automobiles over the ancient highways of Europe, it must be painfully apparent that in comparison America suffers, notwithstanding the fact that in our older communities we have been striving for years to do in a shorter time what has there required many generations of careful work and study.

In almost all of the larger cities of the east in America very large sums of money have been spent in the acquisition of land and the planting of trees and shrubs which will thrive in their respective localities, and in the careful treatment of roadside conditions for many years, and the results of these intelligent efforts have been to make such cities more attractive to visitors and more livable to the inhabitants. It makes the conditions of life more healthful, and has a tendency to improve the people themselves.

The City of Boston in Massachusetts has expended over ten million dollars within the last twenty years in creating a park system for the use and at the expense of the metropolitan district, which, by the care that has been taken in its development, has become one of the most attractive and charming of any in the world; and this same theory has been adopted in many, if not all, of the larger cities, to a greater or less extent, paid for out of the public purse; so that, as I intimated in the first of this paper, so great has the insistence of the public become, that in the treating of public ways or reservations the question of beauty, as it is manifested through the efforts of trained and skilful men, has become a practical necessity, and the public is entirely willing to take upon itself the cost, however great, of such work.

What is true of the parks and other public reservations is true, to a greater or less extent, of the roadsides themselves. It is the custom almost everywhere to plant trees along the sides of roads, wherever practicable, and to save the natural growth on a new road. Wherever the road itself is improved it is noticeable that the land owners living along its borders instinctively improve the appearance of their possessions in proportion to the care that is expended upon the road and its immediate surroundings.

In Massachusetts, where the commonwealth builds and maintains its main lines of travel, and takes care of its roadsides, it is observed that farms and homes, previously deserted for years, are taken up, rebuilt and beautified everywhere along the borders of the road. No deserted farms can be found along State highways in Massachusetts. This, in itself, is an argument sufficient for the expenditure of such additional sums of money as may be necessary for improving the roadsides, as well as the roadways.

The Highway Commission of Massachusetts is required, under the law, to plant useful and ornamental trees along the borders of highways which have been made State roads. In order to do this intelligently and with the best results, the Highway Commission has employed a trained forester, and it has also established a nursery in which are cultivated trees and shrubs which are suited to all the climatic and physical conditions throughout the commonwealth. These trees are planted in locations suited to their character and kind, and are cared for under the direction of the forester, so as to attain their most complete and characteristic growth.

Where, in the course of the construction of State highways, it is necessary to make cuts through hills or embankments over low ground, it is the practice of the Commission to protect and beautify these cuts or fills by the planting of vines or shrubs which conceal their nakedness and prevent their disintegration. The work of the Commission along these lines has produced its effect upon the minds of those living along the roads, so that the ambition of the people to make their places more attractive, by the building of more or less ornamentl fences, the removal of unsightly accumulations, and the general well-being of their homes, has been aroused, and the result is encouraging and satisfactory.

* Paper presented at the First American Congress of Road Builders, Seattle, Wash.

It is also to be considered that trees and shrubs planted along the roadsides protect and prolong the life of the roads, and the planting or preservtion of low-growing shrubs or bushes prevents the action of winds in drying up and removing the surface of the roadway, which otherwise would lead to destruction.

It is very plain that where roadways are shaded by trees horses will draw greater loads for greater distances, and that therefore more may be accomplished than under other circumstances.

You will, of course, appreciate that in a paper such as this is, it is impossible to enlarge upon the method of planting trees or other plans, how it should be done, or what kinds of trees should be used. Your conditions in Washington are so different from ours in the east that what would apply here would be wholly or largely inapplicable there.

It is usual with us, for example, to set out rock maples on the uplands which are exposed to severe winds or extreme climatic variations; white, red or pin oaks on less exposed hillsides or gravelly soils; white, red or pitch pines in sandy soils unprotected from the sun's rays; elms on fertile bottom lands; and white maples and willows in swampy reaches. Chestnuts have not been used to any extent for planting, though they become with care very large and handsome trees. They are, however, protected when found growing naturally by the roadside. Other trees such as poplar, ash, sycamore, locust etc., are suited to certain locations, but are not planted by us to any very great extent.

A great variety of native shrubs, such as cornus dogwood, lilac, etc., are used to give a picturesque effect or as wind breaks in exposed places. Such vines as blackberry, upland cranberry, low-growing sumach, etc., are planted on slopes and banks to protect them from disintegration, and to cover the raw appearance of new work. All these means can well be adopted to beautify and improve the sides of the roads, and, from my experience, are well worth the outlay from any point of view.

## ASPHALT MACADAM ROADWAYS.*

By Clifford Richardson, M. Am. Soc. C. E.

It is somewhat surprising to one who has been a close observer of the development of the modern sheet asphalt pavement in the United States, during the last forty years, that so little application has been made of the experience gained in that industry to the problem of the construction of bituminous macadam highways, which shall meet the conditions which exist to-day.

There should not be any essential difference in principle in the construction of a sheet of asphalt pavement and a bituminous macadam roadway. Both consist of a mineral aggregate cemented together with a bituminous binding material, the aggregate in one case being fine, and the other, containing coarse particles. Experience has shown that, in either type of surface, the mineral aggregate being of a suitable character, the capacity of the resulting surface to resist travel will depend on the more or less satisfactory nature of the cementing material.

In the early days attempts were made to construct pavements in Washington and elsewhere with both fine and coarse aggregates, using coal tar as a cementing material. All these attempts with both fine and coarse aggregates were failures to a greater or less extent and its use was abandoned on the advent of the form of asphaltic construction developed by DeSmedt, although it was revived for a few years in the late 70's in mixture with asphalt with equally disastrous results. The surfaces having a coarse aggregate were somewhat more lasting than those made with sand and a small portion remained in place until the end of the century. They were known as Evans pavements, and were resurfaced with asphalt after a few years. One of these, protected by an asphalt surface, was found on repaving Connecticut Avenue, in Washington, in 1906. A piece of it was collected by the writer and examined. It appears that a coal tar bituminous macadam was constructed as long ago as 1873 and proved, in a short period of time, not to be a lasting form of construction. Notwithstanding this fact, experiment after experiment has been conducted along the same lines in recent years with similar results. Few, if any, highway engineers seem to have benefited by the experience of their predecessors, and most of them still have the coal tar lesson to learn on their own part, although it is evident that this form of construction cannot give satisfactory results for more than a few years.

On the other hand, referring again to the lessons of the paving industry, the modern sheet asphalt pavement, where constructed on rational lines on a rigid, well-drained foundation, has proved a complete success, as exemplified by the fact that a pavement of this type has satisfactorily resisted the heavy travel which is found on Fifth avenue, in New York City, 14,000 vehicles in the period between 6 a.m. and 7 p.m., for a period of twelve years. In the same way, an asphalt concrete surface constructed with a well graded but coarse mineral aggregate in 1902 in Muskegon, Mich., which has been used as a favorite drive since that time, has been in use with no repairs whatever where many similar surfaces in which coal tar has been the cementing material have deteriorated or required resurfacing under similar circumstances during the same period. The Muskegon work has not only demonstrated the superiority of asphalt as a cementing material, but this has been confirmed by other surfaces of the same form of construction in Owosso, Mich., in Paterson, N.J., Scranton, Pa., Staten Island, N.Y., and elsewhere.

The evident conclusion which may be drawn from past and present experiences is that success can be arrived at in the construction of any form of bituminous road surface only by the use of asphalt as a cementing material. The thing to be considered, however, is: how can asphalt be used in building the cheaper forms of country highways which are now in demand, to resist motor and concentrated traffic, where the aggregate is merely of the grading of the ordinary stone which is employed in surfacing macadam roads? The asphalt surface constructed in Muskegon in 1902, and elsewhere, was an asphaltic concrete. The mineral aggregate was well graded and, in itself, compact. This could only be combined with the cementing material in a hot condition, which required a plant to which the aggregate was hauled and from which it was again hauled to the point where it was put in place. The operation was, therefore, an expensive one, and makes the cost of this form of construction prohibitive for country roads. Recourse must, therefore, be had to some other method of combining a mineral aggregate and asphalt immediately on the spot where the surface is to be constructed.

For many years, tar macadam has been laid in England, France, and to a smaller extent, in this country in Rhode Island, New Jersey, and elsewhere. This form of roadway is arrived at by coating the No. 2 or surface stone of the macadam with coal tar in one way or another, either before or after rolling it, and afterwards filling the voids in the surface with more tar and grit, screenings or sand. Such a surface is desirable when first finished, but it soon begins to deteriorate and ravel, especially when exposed to horse-drawn travel, with the weathering and ageing of the cementing material. From past experience, it is not difficult to arrive at the conclusion that if an asphalt cement were substituted for the coal tar a result would be attained which would correspond to the improvement which was evident on the substitution of asphalt for tar in street pavements. The difficulty lies in the fact that an asphalt cement is much more viscous than tar. It must be used in a much better condition and does not mix with or adhere so readily to cold stone. Experiments have shown, however, that this can be accomplished by using a much softer asphalt than is customary in

*Address delivered at the First American Congress of Road Builders at Seattle, Wash.

street asphalt pavements, or even in surfaces of the type of the Muskegon pavement. To-day, we find ourselves, after some experiment, in the position of being able to coat stone, of the type used in macadam surfaces, with an asphalt cement which serves satisfactorily as a binder for such an aggregate, on a metal mixing board with hand labor and shovels, at the point on the road where the material is to be put in place, and with every reasonable economy. It produces a surface which, while not of the stability or having the wearing properties of the Muskegon type, is as far superior to the ordinary tar macadam as the sheet asphalt pavement is superior to one of the tar poultices of thirty-five years ago.

The base of the cementing material must, however, be an asphalt of the best quality, such as is used in the construction of sheet asphalt pavements; in fact, it must be an asphalt paving cement such as is called for under the strictest municipal specifications, but merely made softer by the use of a large percentage of flux. Dense oils and residuums to which no solid native bitumen has been added will not accomplish the same results to any greater or more satisfactory degree than they would if used in a street pavement. Further, the character of the flux in asphalt cements for use in macadam must be more carefully taken into consideration than that for use in street pavements, as the amount is so much larger, in consequence of which, it has a greater bearing on the character of the cement.

## RAILWAY ORDERS.

8093—September 15th—Authorizing Clark Vanderburg, of Nelles Corners, Haldimand County, Ont., to lay gas pipe under the tracks of the G.T.R. where the same crosses at a point on Lot 47, in the Township of North Cayuga, Ont.

8094—September 15—Granting leave to the Mt. Albert Telephone Company to place its wires across the track of the G.T.R. at Lots 11 and 12 at the north end of the G.T.R., (first crossing north of Mt. Albert Station, Ont.)

8095 and 8096—September 15th—Granting leave to the New Brunswick Telephone Company, Limited, to place its wires across the track of the C.P.R. at two points in Carleton County, N.B.

8097—September 15th—Granting leave to the Manitoba Government Telephone System to place its wires across the track of the C.P.R. west of Stonewall Station, Man.

8098—September 15—Granting leave to the rural municipality of Macdonald, to place its wires across the track of the C.P.R. at public crossing 200 feet south of La Salle Station, Man.

8099 to 8101—Inc.—September 15th—Granting leave to the Government of the Province of Alberta to cross with its telephone wires the track of the C.N.R. between mile posts 816 and 817, Alberta, and the Canadian Pacific Railway ¼ mile south of Parkdale, Alta., and at 11th Avenue, Calgary, Alta.

8102 to 8106 Inc.—September 15th—Granting leave to the Bell Telephone Company to cross the tracks of the G.T.R. at three points, and the M.C.R.R. at two points in the Province of Ontario.

8107—September 15th—Granting leave to the Saskatchewan Government Telephone System to cross with its wires the track of the C.P.R. immediately east of the town of Glen Ewen, Sask.

8108—September 15th—Authorizing the Volcanic Oil and Gas Company, Limited, to lay gas main under the track of the C.P.R. where the same crosses McDougall Avenue, between Lot 84 and 85, Township Sandwich West, County Essex, Ontario.

8109—September 15th—Authorizing the C.P.R. to construct bridge No. 84.7 at Six Mile Creek, Mountain Section of the Pacific Division of its line of railway.

8110—September 14—Authorizing the Vancouver Power Company to cross with its tracks the tracks of the New Westminster and Southern Railway Company at Cloverdale, B.C.

8111—September 15th—Directing the Brandon, Saskatchewan & Hudson Bay Railway to employ two men and a foreman on each of the sections known as the "Boissevain and Minto Sections," and if that number be not sufficient that the railway company is to employ such additional men as may be necessary for the purpose.

8112—September 16th—Granting leave to the Volcanic Oil and Gas Company to place its wires across the track of the P.M.R.R. at the intersection of the railway of the said company with town line between Townships Tilbury East and Romney, County Kent, Ont.

8113—September 16—Granting leave to the Saskatchewan Government to place its wires across the track of the C.N.R., between Sections 21 and 28, Tp. 34 33, R. 4, west 3rd. Meridian, Saskatchewan.

8114—September 16th—Granting leave to the Rural Telephone Company, Limited, to place its wires across the track of the C.P.R. at Valley Street, Govan, Sask.

8115—September 15th—Authorizing the C.P.R. to construct, maintain, and operate industrial spur near "McLeods," Township of Hampden, County of Crompton, P.Q., for the Lake Megantic Pulp Wood Company.

8116—September 21st—Authorizing the C.P.R. to construct, maintain, and operate, branch line on Alley West of Caron Avenue, Windsor, Ont.

8117—September 21st—Authorizing the C.P.R. to construct bridge No. 69.8 on its Moose Jaw Section.

8118—September 17th—Authorizing the C.P.R. to construct bridge No. 42.15 on the Schreiber Section, Lake Superior Division of its line of railway.

8119—September 21st—Approving location and detail plans of stations of the C.N.R. on its Ottawa-Hawkesbury and Garneau-Quebec Divisions.

8120—September 14th—Dismissing application of the G.T.R. for permission to construct spur into the premises of the Noxon Company, Limited, near Ingersoll, Ont.

8121—September 21st—Approving location of the C.N.R. from mileage 10 to mileage 15, up the Fraser River from Yale, B.C.

8122—September 21st—Granting leave to the Ontario Power Company to place its transmission line across the track of the N. St. C. & T. Railway between Lots 17 and 30, Township of Thorold, Ont.

8123—September 21st—Approving revised location of the G.T.P. Railway from S.E. ¼ Sec. 14 to the S.W. ¼ Sec. 23, Tp. 14, Range 27, west 1st Meridian, District of Shoal Lake, Man.

8124 to 8127 Inc.—September 21st.—Granting leave to the Saskatchewan Government Telephone System to cross with its wires the track of the C.P.R. at four different points in the Province of Saskatchewan.

8128—September 21st—Authorizing the corporation of the town of Weyburn, Sask., to lay water main under the tracks of the C.P.R. at Third Street, Weyburn, Sask.

8129 to 8131 Inc.—September 21st—Granting leave to the B.C. Telephone Company to place its wires across the track of the Vancouver, Victoria & Eastern Railway at three points in the Province of British Columbia.

8132 and 8133—September 21st—Granting leave to the Bell Telephone Company to cross with its wires the track of the C.P.R. at West Brome, P.Q., and the G.T.R. at Clinton, Ont.

8134—September 21st—Granting leave to the Canadian Machine Telephone Company to cross the track of the G.T.R at Mount Pleasant Flag Station, Ont.

8135—September 21st—Granting leave to the Volcanic Oil and Gas Company to place its wires across the track of the M.C.R.R. at public crossing at Lot 9 North Middle Road, and Lot 9 South Middle Road, Ontario.

8136—September 17th—Granting leave to the corporation of the town of Milton, Ont., to lay water main under the track of the C.P.R. at Court Street in the said town.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

**MUNICIPAL ASSOCIATIONS**

ONTARIO MUNICIPAL ASSOCIATION.— President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF NOVA SCOTIA MUNICIPALITIES. — President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING — CONTRACTORS.—President, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION. — President, Thomas Southworth; Secretary-Treasurer, King Radiator Co., Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Rd., Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H Warder, Secretary.

## COMING MEETINGS.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**American Society of Municipal Improvements.**—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

**Royal Architectural Institute of Canada.**—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will shortly be invited for rebuilding the St. Catherine St. bridge. Mr. John R. Barlow is the city surveyor.

MONTREAL.—Tenders will be received until October 6 for alterations to the examining warehouse, Montreal. Mr. guori, Montcalm County, Que.; J. L. Michaud, Resident Engineer, Merchants Bank Building, Montreal; Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

QUEBEC.—Tenders will be received until Friday, October 22nd, for the construction of an Ice Breaker at St. Liguori, Montcalm County, Que. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

**Ontario.**

BERLIN.—Tenders will be received until Thursday, October 28th, for paving King Street. A. H. Millar, town clerk; Wm. Mahlon Davis, C. E., town engineer. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will shortly be invited for two new steam fire engines for the city of Toronto.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, October 11th, for the construction of sewers in the township of York. Barber & Young, York Township Engineers, Toronto. (Advertisement in the Canadian Engineer.)

WELLAND.—Tenders for Postoffice, Customs and Inland Revenue Fittings, will be received until Monday, October 11. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

**Manitoba.**

SHELLMOUTH.—Tenders will be received up to the 27th October for building a bridge across the Assiniboine river. Plans and specifications can be seen at the office of the department of public works, Winnipeg. F. G. Richardson, Clerk.

**Saskatchewan.**

MAPLE CREEK.—Tenders will be received until October 15th for sewage pumping equipment. H. A. Greeley, secretary-treasurer; C. M. Arnold, consulting engineer, Lethbridge. (Advertisement in the Canadian Engineer.)

MELVILLE.—Tenders will be received until October 7th for a drainage system. H. D. Wilson, secretary-treasurer, Melville; L. B. Merriam, consulting engineer, 609 Builders' Exchange, Winnipeg. (Full particulars advertised in the Canadian Engineer.)

MOOSE JAW.—Tenders will be received until Monday, October 11th, for 50 water meters and connections. J. Darlington Whitmore, city engineer. (Advertisement in the Canadian Engineer.)

**British Columbia.**

VANCOUVER.—Tenders will be received until October 25th for building a large bridge over False Creek, this city. W. A. Clement, city engineer; Waddell & Harrington, consulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

VICTORIA.—Tenders will be received until Monday, October 11th, for 2,500 feet of 12-inch pipe; 15,000 feet of 8-inch; 20,000 feet of 6-inch and must be delivered in 30-feet lengths, covered with jute and double coated, inside and out, with asphalt solution. Delivery must be made by March 15th next. W. W. Northcott, purchasing agent.

## CONTRACTS AWARDED.

**Quebec.**

MONTREAL.—Messrs. Quinlan and Robertson, of Montreal, secured the contract for widening and deepening the aqueduct for $815,690. A complete list of the other tenders appears on page 314 of our issue for September 17th.

MONTREAL.—Mr. Justice Davidson has rendered judgment dismissing the action in a case of Nicholson vs. the Town of St. Pierre. This was a petition to set aside a resolution of the municipal council granting a $31,000 contract to Messrs. Henault & Heffernon for the construction of sewers. The proceedings were taken on the ground that the contract had been previously awarded to another party, but the court maintained the town's plea that it was justified in reconsidering the first award.

**Ontario.**

TORONTO.—A contract for steel by the ton for use in the rebuilding of the Parliament buildings, has been awarded the Dominion Bridge Co., Ltd. of Montreal. T. V. Gearing was awarded the contract for carpenter work. Tenders for stone and brick to be delivered immediately will be asked for.

TORONTO.—The Board of Control recently awarded contracts as follows: McKnight Construction Co., sewers; Godson Contracting Co., sewers, asphalt pavements; Maguire Co., sewers and pavements; Excelsior Co., pavements; Barber Asphalt Co., pavements; Contracting and Paving Co., pavements; Warren Bituminous Co., pavements; Queen City Co., concrete pavements.

ST. CATHARINES.—Messrs. J. & T. Riley have been given the contract for sewers at $830. Messrs. Newman Bros. bid $880.

**Manitoba.**

WINNIPEG.—The contract for the new telephone exchange building near the corner of Portage avenue and Sherbrooke street, was let to Messrs. J. J. and J. M. Kelly, contractors of this city, the price being in the neighborhood of $43,000. Work on the building will be commenced immediately, so that the structure may be roofed in before winter and ready for occupation in the spring. The contract for the switch board, which will cost in the neighborhood of $150,000 has been let to the Northern Electric company, and operations for its installation are already under way.

WINNIPEG. — The principal contract for the interior equipment of the McArthur building, Winnipeg's new skyscraper has been let at a price of about $47,500. The contract calls for plumbing, heating and ventilation and the successful tenderers are Green & Lister. The plant to be installed will be, it is said, the most modern in the city. Every office in the building will be supplied with fresh air, and in the winter this will be brought over tempering coils and through an air washer, and then forced into the various rooms. The Otis Fensom Elevator company will put in the three high speed elevators. The contract price for these is $25,000. The contracts were let by J. H. G. Russell, architect.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—Work on the enlargement of the Turcot freight yards so as nearly to double their capacity, has just been started by the Grand Trunk Company. At present the yards have a capacity for 4,000 freight cars, but the company has a large enough site to increase the capacity to 15,000 cars when necessary. In view of the present extension, the Lachine line of the Park and Island Railway will be moved over six hundred feet towards the Canada Car Company's works. It is probable that the G. T. R. will also start on the enlargement of the terminals at St. Lambert in the spring. Over two hundred acres of land in the vicinity of the station have been purchased with this object.

**Ontario**

MORRISBURG.—The town of Morrisburg, on September 25th, voted to give the Canadian Sheet Steel Corporation a sixty-year franchise of its hydro-electric power plant and right of way through the principal streets for an electric railway. There were only ten votes recorded against the by-law.

OTTAWA.—A hundred and fifty men are busy in the vicinity of Hurdman's Bridge, rushing work on the Canadian Northern Railway, which is being built into the city. Work has just started on the west side of the Rideau on a steel bridge that is to be laid across the river, so as to afford an entrance into the city. Men have started laying the piers, and the work will be rushed just as rapidly as possible. There will be nine piers made of concrete, and the superstructure will be of steel, somewhat similar to the Ottawa & New York railway bridge, that is south of the one over the main road. On the other side of the river (the east) the work of track-laying is going on. A gang of men are busy and the tracks are daily getting nearer to the east shore. The bridge referred to will be run from the west side to the east and will join the tracks there.

OTTAWA.—An application will be made to parliament at the next session to incorporate the Nelson River Railway company. The company proposes to construct a railway from a point on Lake Winnipeg, near the Nelson river or the Saskatchewan river, to a point of junction with the proposed Hudson Bay railway.

TORONTO.—It was announced on Tuesday, that Mr. Angus Sinclair, of Toronto, had been the successful tenderer for the construction of the Toronto-Trenton division of the Canadian Northern line to Ottawa. Six tenders were received by Messrs. Mackenzie & Mann. Mr. Sinclair's contract calls for the completion of this 104 miles of road within a year. He will start work at once at different points along the line. Mr. Sinclair has had charge of a good deal of railway construction work. He built a considerable portion of the C.N.O. line between Toronto and Sellwood, and also constructed a portion of the Inverness & Richmond Railroad in eastern Canada, another Mackenzie-Mann enterprise.

**Alberta.**

EDMONTON.—Mr. W. E. Mann, divisional engineer for the G. T. P. returned recently from a trip of inspection over the new line as far west as the Macleod river. He says the Pembina bridge will be completed in two months and that the line will be ready for operation to Macleod by that time.

LETHBRIDGE.—A company is being organized to build and operate a street railway in Lethbridge and connect it with Royal View and other towns in the near vicinity.

**Saskatchewan.**

PRINCE ALBERT.—A party of Grand Trunk Pacific engineers is in the district of Duck Lake, locating a line from Watrous to Prince Albert.

**British Columbia.**

VANCOUVER.—The Canadian Northern Railway has purchased Anacis island, which lies at the mouth of the Fraser river, twenty miles from Vancouver. It contains 900 acres and will be the site of the shops, elevators, etc., for freight shipping. The probability is that the Canadian Northern will use the Hill line across the Fraser and into the city for passenger business.

PRINCE RUPERT.—The contract for extending the railway right-of-way along the front of the townsite to Seal's Cove has been let. Messrs. Foley, Welch & Stewart have signed the documents, and Mr. Stewart let the sub-contracts. The work is probably the heaviest along the road and will involve an expenditure of over half a million dollars. The length of the extension is three and one half miles, and if it is double-tracked it will cost from $800,000 to $1,000,000. The work is to start immediately and continue through the winter. It will take probably a year to complete the job. The contract is sub-divided into two sections, of about equal proportions. Angus Stewart gets the first half, and V. W. Smith & Co., get the outer section.

VANCOUVER.—Contracts for the last section of the C.P.R. Alberni branch will probably be let this week or next. The tenders are now being considered.

VICTORIA.—Speaking of the Alberni extension of the C.P.R. to north end of Island, Mr. R. M. Marpole, general executive assistant of the C.P.R., recently said that the surveys between French Creek and Union Bay were still going on. The first rough survey was now being followed by the final locating of the line which would have to be finished before the railway could be built. Two parties had been working, one from Union Bay north to Black Creek, a distance of over 20 miles, and the section south of that between Union Bay and French Creek. The northern section south had been already completed, and the surveyors were now all working on the southern section.

## SEWERAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—The roads committee is asking for $50,000 for another section of the Sherbrooke sewer.

**Ontario.**

COBALT.—Work has been started on the permanent water and sewage system at the Lake Sasaginaga end and Mr. French, representing Newman & Co., of Winnipeg, assures Town Engineer Sutcliffe that he will have water on the Square in a month's time. It is expected that tenders for the proposed new septic tank and filter for the disposal plant will be called for shortly, though work on these will not start until next spring.

OSHAWA.—The town council have of late been compelled through legal proceedings to pay large sums to farmers owing to the pollution of the Oshawa Creek by sewage. Several cattle have been affected by enteritis. The council have decided to call in Mr. T. Aird Murray, C. E., of Toronto, to prepare a scheme and estimate of the cost for the purification of the town sewage before discharging it into the creek in accordance with the modern method of biological method of purification.

OTTAWA.—In the Exchequer Court last Wednesday, hearing was begun in the case of E. A. Wallberg of Montreal, who claims from the Government $105,000 for drainage and waterworks extras in connection with the Moncton Car Shops of the I. C. R.

**Manitoba.**

SELKIRK.—On Monday tenders closed for the supply and installation of gasoline engines, pumps and elevated water tanks. Mr. C. A. Millican, C. E., of Winnipeg, has charge of the works.

## LIGHT, HEAT, AND POWER

**Ontario.**

PORT ARTHUR.—The city has commenced laying underground telephone conduits on Arthur street. The plan is to have all wires under ground in the business section.

TORONTO.—The conduits for the cable for the civic electric power plant have been constructed on John street, from Adelaide street Wellington street, in the course of the conduits being laid to the city waterworks, at the foot of John street.

LADYSMITH.—Work has commenced on the new power house and the council are considering the question of using meters.

VANCOUVER.—The Burrard Power Company has received from the Dominion Government a grant of 25,000 miners' inches of water on Lillooet river. Under the terms of the grant the harnessing of the waters of the Lillooet will be commenced at no distant date, and as the power plant will be only 23 miles from Vancouver, it is declared that it will not be long before some sections of industrial Vancouver will be drawing power from this source.

## CEMENT—CONCRETE.

**British Columbia.**

NELSON.—A number of cement sidewalks will be constructed by this city.

VANCOUVER.—Concrete piers, which are to be sunk by the pneumatic process, and concrete pedestals, will be used in a bridge 3,375 feet long, to be erected over False Creek, Vancouver, by Waddell & Harrington, consulting engineers, Kansas City, Mo., for the city council, who will receive tenders for the work of erection until October 25th. Mr. W. A. Clement is city engineer, and further particulars appear in our advertising columns.

## TELEPHONY.

**Quebec.**

MONTREAL.—Extensions to the lines of the Bell Telephone Company have been approved of as follows:—Exchange-Aerial.—Tilbury, Ont.; Levis, Que. Rural lines.—St. Thomas, Port Stanley, Wellandport, Winslow, Ormstown, English River. Underground.—Sault Ste. Marie, conduit and cable; Montreal (St. Louis), conduit; Montreal, (Westmount), conduit. Long distance lines.—Sherbrooke, Black Lake, Ridgeville, Marshville.

## CURRENT NEWS.

**New Brunswick.**

FREDERICTON.—Dr. H. Ries, of Cornell University, and Mr. J. Keele, of the Dominion Government Survey, have been in New Brunswick for some time inspecting the clays and shales. The object of this inspection is for the purpose of finding out if crockery, fire-brick, sewer pipe, etc., can be manufactured there. Large samples of the clays and shales from different localities will be sent to Ithaca, N.Y., to be tested during the coming winter, and a report will be made as to their suitability for the above purposes. Owing to the opening up of large iron mines and other industries in the Maritime Provinces it is most important that a good quality of fire-brick be manufactured here. Large quantities of shale have to be mined along with the coal of Grand Lake, and up to the present the mine owners have not utilized this enormous by-product. If, as Mr. J. J. Winslow, the Fredericton, N. B., Board of Trade Secretary, tells us, Dr. Ries reports favorably upon these shales, a large industry for New Brunswick will be the result.

**Ontario.**

TORONTO.—Canadian Contracts, Limited, is the name of a new engineering and contracting organization to which a charter has been granted. The headquarters of the company will be in Toronto and the capital is $100,000. The officers are: President, W. A. Lamport; vice-president, William de Leigh Wilson; managing director and secretary-treasurer, C. H. Mortimer. The new company is well equipped for the carrying out of contracts for engineering works of all kinds, including the construction of power transmission and telephone lines.

**British Columbia.**

VICTORIA.—The Jordan-Wells Railway Supply Company, Limited, has been incorporated with capital of $150,000 to carry on the business of manufacturing supplies for railway and tramcars, rolling stock, bridge work in metal, steamship appliances, machinery, etc.

## FINANCING PUBLIC WORKS.

**Nova Scotia.**

SYDNEY.—A firm operating a shipbuilding plant here intend to ask the city for a bonus of $400,000.

**Quebec.**

MONTREAL.—The city of Montreal is authorized by the legislature, to borrow $24,100,000, for the construction of a high pressure system, underground conduits, elevating the G. T. R. tracks and for the purchase of the Montreal Water & Power Company.

**Manitoba.**

BIRTLE.—Telephone debentures amounting to $5,000, are offered for sale by Mr. J. C. Dudley, town clerk here.

PORTAGE LA PRAIRIE.—The ratepayers will shortly vote on a by-law to raise $17,500 for waterworks.

ST. BONIFACE.—This municipality has sold debentures amounting to $100,000 to Messrs W. A. Mackenzie and Co., of Toronto.

**Saskatchewan.**

SASKATOON.—Local improvement by-laws which call for the expenditure of $130,000 have been sanctioned by the ratepayers of Saskatoon. The most important was a by-law to provide $70,000 for the construction of a subway under the C. N. R. tracks.

**Alberta.**

NANTON.—The ratepayers vote to-day on a by-law to raise $16,000 for an electric light plant.

**British Columbia.**

NELSON.—The city council have passed the street railway by-law and it will be submitted to the ratepayers on October 7th for ratification.

NEW WESTMINSTER.—Until October 15th, Mr. H. P. Latham, city treasurer of New Westminster, will receive tenders for debentures which include $234,000 for waterworks, $104,000 for street improvements and $20,000 for an incinerator.

VANCOUVER.—On Saturday, October 23rd, the ratepayers of Vancouver, will vote on by-laws to borrow $675,000 for bridge across False Creek, and $400,000 for waterworks requirements.

## MISCELLANEOUS.

**Quebec.**

MONTREAL.—Plans for the Montreal harbor improvements, which are to be carried out by the Harbor Commissioners, when a loan is negotiated from the Government, are nearly ready. The board of engineers is considering the two sets of plans submitted by Mr. F. W. Cowie, Montreal, harbor engineer, and by Mr. Davidson, the English engineer, and have practically finished their deliberations after many months' work. The details will be submitted shortly to the Harbor Commission. If they are then approved they will be laid before the House of Commons with the request for a loan to carry out the scheme.

**Ontario.**

TORONTO.—A branch factory of the Steel Shoe Company, of Racine, Wis., will be established here shortly.

## PERSONAL.

MR. NATHANIEL BEAM has been appointed waterworks engineer by the town of Waterloo.

DR. EUGENE HAANEL, Director of Mines, Ottawa, has been chosen president of the American Peat Society, now in session at the Massachusetts Institute of Technology, Boston. This honor is in recognition of his systematic investigation of peat bog in Canada.

MR. F. H. BANBURY, engineer of the Acheson Oildag Company, of Niagara Falls, sailed for Europe on the steamer

"St. Louis," Saturday, September 25th. Mr. Banbury is an Englishman by birth. He came to America about five years ago and won degrees as a Mining, Mechanical, and Electrical Engineer. A little over a year ago he became connected with the Oildag Company. Dr. Edward G. Acheson is president of the Oildag Company, and it was he who gave the world Deflocculated Graphite as a lubricant.

## ONTARIO'S HYDRO-ELECTRIC PROBLEM.

A meeting was held in Toronto, September 29th, for the purpose of renewing the interest of the municipalities in the Hydro-Electric power scheme. The commission was represented by Hon. Mr. Beck, Mr. W. K. McNaught, M.P.P., and Engineers P. W. Sothman and E. Richards, while the visitors included Ald. Wm. Trott, P. Meehan, and G. Roche, St. Thomas; Councilman L. E. Weaver, Hespeler; Mayor A. Weidenhammer, Waterloo; Engineer K. L. Aitken, Toronto; Mayor C. C. Hahn, Berlin; Engineer E. J. Philip, Berlin; Engineer E. J. Sifton, London; Engineer J. J. Heeg, Guelph; Ald. L. H. Reesor, Chairman of Light and Water Committee, St. Mary's; Engineer W. R. Reynolds, St. Mary's; Engineer Geo. L. Oill, St. Thomas; Mayor Dingman, Ald. J. Davis Barnett, Chairman of Water Commission, and Chief Myers, fire department, Stratford; Engineer James Abell, City Solicitor W. B. Doherty, and Mayor Geo. Geddes, St. Thomas; Ald. R. N. Price and S. Chance, St. Thomas, and others.

Following an informal discussion the engineers and mechanical superintendents organized. Mr. R. A. Ross, Montreal, consulting engineer of the commission, was chosen Chairman, and Mr. E. Clarence Settell, Secretary of the commission, Secretary. Municipalities who have not at present civic lighting and power service were represented at their request by Mr. P. B. Yates of the commission's engineering staff. Much technical conference work was gone over in detail.

## MARKET CONDITIONS.

Montreal, September 29th, 1909.

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk stee', $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15, 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.64, 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 28-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24 gauge, $4.65; 28-gauge American, $4.75; 30-gauge American, $5.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are—Queen's Head, $4.40; Comet, $4.25, Gorbal's Best, $4.25; Apollo, 10½ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10½ oz., and English 28-gauge.

**Galvanized Pipe.** (See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pioe, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in galloo cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62¼ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-ioch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchaoged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, September 30th, 1909.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand inactive, market unchanged at $9 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Shipments are fairly heavy, mainly on existing contracts, and not much new business is offering. An indication of a disposition towards greater stiffness in the market is afforded by the following quotation made to-day by a large producing company:—"Our price to-day for Portland cement, f.o.b. Toronto, is $1.70 net cash including cotton bags, for acceptance within 10 days from date of quotation, and for shipment within 30 days from date of acceptance." According to stories in the newspapers, the cement merger is assuming shape. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra; in shop, $1.35. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is laregly used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75: Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.** The market is very fiem, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

**Detonater Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the interests of the**

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**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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TORONTO, CANADA, OCTOBER 8, 1909.

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**If you have no further use for your copy of the Canadian Engineer of September 17th, our circular department will be obliged if you will kindly return it to Box 21, Toronto, and receive in return one month's extension of your subscription.**

## DIVIDED RESPONSIBILITY.

For efficient work, a department must have but one head. Divided authority in street control or any other work is to be regretted, and must lead to no end of trouble.

Just recently one of our most important Western cities decided that from this time forward the city engineer was to have full charge, and to be wholly responsible for the condition of the city streets. It is hard to imagine that for years the city engineer, the waterworks commissioner and the gas and light commissioner could each do as he liked with that part of the city street he required for his own work.

The water commissioner would open a trench for a main; the gas commissioner would tear up a street to make a gas connection, and in neither case could the city engineer—the man who was supposed to provide good pavements—interfere. As a result, complaints as to the manner in which the streets were left were frequent. Responsibility could not be fixed, and wrangling and discontent resulted.

The city engineer should have full control of city streets; he should be the man of authority and responsibility. Let the other departments using the streets do so at the option of the city engineer.

## CONGESTION ON YONGE STREET, TORONTO.

The congestion of certain parts of Yonge Street, Toronto, has led the city engineer's department to make a count of vehicular and foot traffic passing a certain point.

The day on which one count was made was September 28th, an ordinary day in the city's affairs. It was found that the greatest vehicle traffic at Queen and Yonge Streets was between 4.30 and 5.30 p.m., when the count was 97 going north and 120 going south. Although the Queen and Yonge Street corner (the departmental store district) was the centre of congestion in the afternoon, yet it was found that King and Yonge Streets corner was the centre of traffic in the forenoon. The hour between 10.30 and 11.30 a.m. gave the maximum of traffic.

Between 6.30 a.m. and 6.30 p.m. about 22,000 people walked down Yonge Street past Adelaide.

The eccentricities of city traffic are many, but in large centres of population it is the duty of the city engineer to be prepared with information as to the traffic not only this year, but in previous years.

Figures of traffic at any period are of more value if there are available other data for comparison.

## THE ELECTRIC FURNACE.

Elsewhere in this issue we give considerable space to an extract from the report of Dr. Eugene Haanel,

Director of Mines for Canada, in which he deals with the Swedish electric furnace, its design and efficiency.

Although electric smelting is still in the experimental stage, the measure of success that has attended the working of this new furnace leads one to expect that within a few years it will be perfected so that as a commercial scheme electric smelting will shortly be established in Canada.

## EDITORIAL NOTE.

The Department of Trade and Commerce, Ottawa, are preparing a list of Canadian firms, their addresses and the articles they manufacture. With this list as a basis they expect to be able to assist the export trade of Canada in addition to being able to assist in the interprovincial trade. It is to be hoped Canadian manufacturers will assist, as the Department has taken upon itself a large task, but if carried out should do much for Canadian trade.

## OCTOBER MEETINGS OF A.S.M.E.

Meetings of the American Society of Mechanical Engineers are to be held during the month of October as follows:

In New York, on Tuesday evening, October 12th, at 8 o'clock, in the Engineering Societies Building, with a paper by Prof. R. C. Carpenter, of Cornell University upon the High-Pressure Fire System of New York City.

In St. Louis, jointly with the Engineers' Club of St. Louis, on Saturday evening, October 16th, when Prof. Carpenter will again present his paper upon the high-pressure fire system.

In Boston, on Wednesday evening, October 20th, at 8 o'clock, jointly with the Boston Society of Civil Engineers in Chipman Hall, a paper will be presented by Prof. Gaetano Lanza and Lawrence S. Smith on Comparison of Results obtained by the Use of Three Theories of the Distribution of the Stresses in Reinforced Concrete Beams, with the experimental results.

In conducting meetings in St. Louis and Boston the Society is entering into broader activities than ever before and affording the membership a greater opportunity to attend meetings, participate in the discussion of papers and meet members and engineers in attendance at the meetings. The meetings in St. Louis and Boston as well as in New York are to be regular meetings of the Society, with the same standards maintained in regard to papers, discussion and general conduct of the meetings that have been established by the conventions and other regular meetings of the Society held in previous years.

Of the two papers to be given in October, that by Prof. Carpenter, gives a technical description of the high-pressure fire system of New York City and the results of tests made upon the pumps and distributing mains. The first high-pressure fire system in the country was installed at Detroit in 1898, where it was designed to fill the mains by means of centrifugal pumps on boats. There are now systems installed or in process of construction in Philadelphia, Brooklyn, Baltimore, Boston, Buffalo, San Francisco, Toronto, and possibly other places. In some of the installations multi-stage centrifugal pumps are employed and in others plunger pumps are used. There is, therefore, an opportunity for discussion of high pressure systems, as such, and also of the relative advantages and characteristics of different types of pumps for high pressure work.

The paper by Professor Lanza and Mr. Smith gives the results of extended experiments upon full-sized reinforced concrete beams with well-developed theories, forming an important contribution to the all-important subject of reinforced concrete construction.

## ROYAL ARCHITECTURAL INSTITUTE OF CANADA.

The second general annual meeting of the Royal Architectural Institute of Canada was held at Toronto, October 5th and 6th.

Mr. A. F. Dunlop, the president, in his opening address, remarked that the main object of the Royal Architectural Institute of Canada is the better education of its members in the principles of coming art. The society has this one great object in view, and is bending all its efforts to the accomplishing of it. He also referred briefly to the association's position in the Province of Quebec, and gave an emphatic contradiction to the rumor that members had been taken into the association from that Province illegally.

Addresses were also made by Mr. Eden Smith, President of the Toronto Society of Architects, and by Mr. G. W. Gouinlock, President of the Ontario Association of Architects. Mayor Oliver was to have made an opening address to the society, but in his absence the President read a letter of congratulation and regret from him. Routine business occupied the balance of the session.

The Treasurer's report showed total receipts of $1,032.10, and a balance on hand of $803.61. Last year's balance was only $190.85.

Most of the afternoon was taken up with a discussion on the federation of the various architectural bodies. Last April a conference took place in Toronto between representatives of the various architectural associations in Canada, and five resolutions were drawn up to be submitted to the present meeting of the Canadian Institute. The resolutions of the joint meting were finally approved, and will now come before the council or executive of the Institute for consideration. They are as follows:—"(1) The conference recognizes the necessity of the Architectural Institute of Canada as a representative Canadian body. (2) The conference considers that each province should have an official body and that membership in the Architectural Institute of Canada should be composed solely of members of the Provincial bodies. (3) That architects should qualify for and pay entrance and annual dues to the Provincial bodies only, and the Provincial bodies contribute a per capita fee to the Architectural Institute of Canada. Members of the Provincial bodies shall thus become members of the Dominion body. That voting in the Architectural Institute of Canada should be by delegates of the provincial bodies. That provision should be made for existing members of the Architectural Institute of Canada who do not now belong to Provincial Associations."

A discussion then took place on "The possibility of a national status for architects in Canada." Papers were read by Messrs. J. W. H. Watts, of Ottawa, and J. P. Hynes, and H. B. Gordon of Toronto.

The Treasurer's report showed total receipts of $1,032.10, and a balance on hand of $803.61. Last year's balance was only $190.85. The present session of the association is attended by about 30 delegates from all parts of the Dominion.

The National Association of Railway Commissioners will hold their annual meeting at Washington, D. C., beginning Tuesday, November 16. The secretary is William H. Connolly, Washington.

# RELATION OF LOAD FACTORS TO POWER COSTS.*

J. M. S. Waring.

I have so interpreted this title as to include in the power costs the fixed charges incident to the generating, transmission apparatus, etc., as well as the operating expenses, for there is a relation between the load factor and these fixed charges as well as between the load factor and the actual operating cost.

The fact that these relations exist (and that, other things being equal, the higher the load factor the less the fixed charges and operating expenses for any given energy output), is so well known that an attempt to prove these facts would result in a demonstration of a self-evident proposition, and I will, therefore, begin with the assumption that the fact is admitted, and will devote the major part of this paper to the description of a comparatively novel application of storage batteries where the ultimate benefit is an improvement in the load factor.

As a matter of fact, the installation of all storage batteries for railway and central station service has been made with a view of improving the load factor of the entire system or of some part of the system.

Most of these varied applications are well known to-day, and the time is too limited to make more than a passing reference to them. There is an application, however, that until recently has received comparatively little attention, but whose field is constantly enlarging, and will, I believe, result in more battery installations for railway, lighting and power service than any other single application. In order to obtain a comprehensive understanding of this application it will be necessary to lead up to it by a brief and necessarily academic discussion of power rates. This, I feel, will be justified in view of the facts that the value of the battery installation is here dependent on the nature of the rate, and that the result in this case, as in all the others cited, is the betterment of the load factor.

It is needless to say that for a power company to be on a paying basis, its total revenue must be more than sufficient

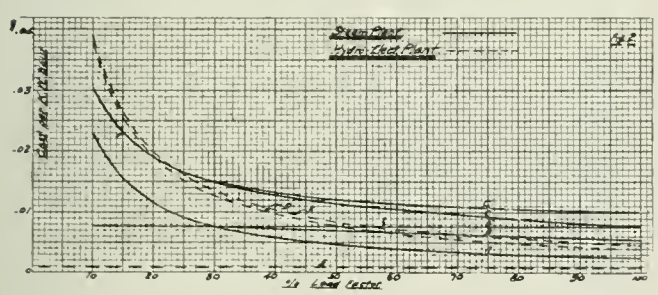

Fig. 1.

to cover all fixed charges and operating expenses. The total expenses of a power company may be divided as follows:—

(A) Fixed charges on equipment, including power house apparatus, transformers, transmission lines, etc., namely, interest, depreciation, taxes, insurance, etc.

(B) Operating expenses made up of such items as fuel and feed water, if it is a steam plant; oil, waste, incidentals, repairs and labor, including power house force, linemen, etc.

(C) Organization expenses, including salaries of officials, clerks, solicitors, etc., office rents and such expenses.

*Paper read before the Western Society of Engineers.

If each customer of a power company is paying annually an amount sufficient to cover the fixed charges, operating and organization expenses, incident to his demand only, plus a reasonable profit to the power company, his rate is a just one, and every well organized power company knows that an unfair discrimination in rates must finally be disastrous. Power companies are, therefore, realizing more and more the necessity of adopting a form of rate which will do justice to all of their customers as well as to themselves, and the tendency to-day is the adoption of a form of rate which will pro-rate the total expenses of the operating company as equitably as possible among its customers. In order to accomplish this: First—All fixed charges and fixed expenses, namely, those that are constant and irrespective of the

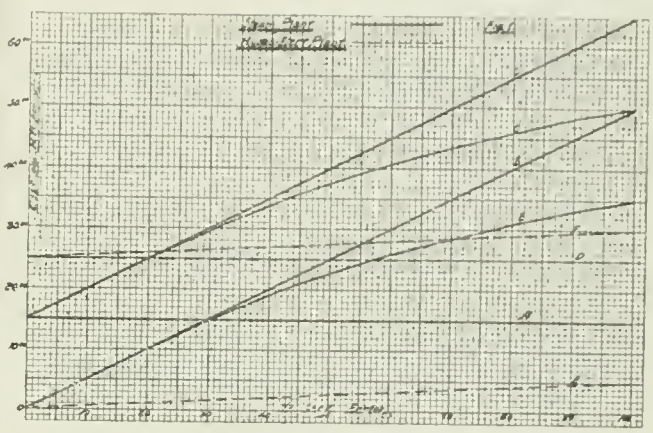

Fig. 2.

energy output of the plant should be divided among the customers in proportion to their maximum demand for power; then each customer pays the fixed charges and fixed expenses on the apparatus set aside for his use.

Second—All variable expenses, namely, those varying with the energy output of the plant should be divided among the customers in proportion to the energy they consume in a fixed time.

Of the various expenses under the headings, "A," "B" and "C," referred to above, the only variables in the case of a hydro-electric plant are the repairs, oil, waste, incidentals, and probably only a small part of the power house force, all the other expenses being practically fixed and independent of the load factor. In the case of a steam plant, however, the variables would include oil, waste, incidentals, fuel, feed water, repairs and a larger percentage of the power house force than would occur in the hydro-electric plant. Therefore, in general, the operating expenses, that is, the variable charges, are a greater percentage of the total operating cost in the hydro-electric than in the steam plants. Now, the total fixed charges of the plant divided by its kilowatt capacity will give the amount per kilowatt which each customer should be charged for each kilowatt of his maximum demand. By doing this, the total fixed charges are properly pro-rated among the customers in the manner outlined above. The total operating expense of the plant for a fixed period of time, divided by the kilowatt hours output for that period will give the cost per kilowatt hour of the actual operating expenses, exclusive of the fixed charges, and this amount plus the company's legitimate profit would be the kilowatt hour rate that the customers should pay for their energy consumption. In other words, an equitable basis of power rates is the one where a customer is billed annually a fixed amount per kilowatt of his maximum peak, which we may call a primary charge, and

is billed in addition to this a fixed amount per kilowatt hour, which we will call the energy charge. Power rates may apparently differ from this in form, but to be equitable they must be reducible to this basis, and a rate which is not reducible to it is not equitable. In order that this form of rate, or its equivalent, may be put in force it is necessary that the consumer's load factor be known in each case. His average load may, of course, be determined by an integrating watt meter. His maximum load, however, must be determined in order to establish the load factor. Usually the most accurate way of determining this maximum is by means of a meter, such as the Wright Demand meter, or a recording instrument.

Notwithstanding the fact, that the number of equitable rates in force is constantly increasing, I could cite actual cases of rates in force to-day, varying from the equitable basis referred to above to the other extreme of the flat rate of a fixed amount per month per lamp connected. It may be interesting to mention several of these cases with a view of analyzing them, and determining how nearly they approach the equitable basis.

These analyses will, I believe, be made clearer by using the curves shown on Figs. 1 and 2 as illustrations. On each sheet the curves relating to steam operation are shown by the solid lines and those referring to hydro-electric plants by the dotted lines. In Fig. 1 the curves are plotted between per cent. load factor and cost per horse-power per year, curve A representing the fixed charges of a steam plant; curve B, the variable expenses; curve C, being a summation of A and B. Curve D represents the fixed charges of an hydro-electric plant; curve E, the variable expenses; curve F being a summation of D and E. All of these curves may be reduced to curves as shown on Fig. 2, which is plotted between per cent. load factor and cost per kw. hour, the cost per kw. hour, at any load factor being equal to the cost per horse-power per year at the same load factor, divided by 8760 and multiplied by 0.746, multiplied by the load factor. Thus, curve A, Fig. 2, is deduced from curve A, Fig. 1, the other curves in Fig. 2 being obtained in the same manner; the factor 8760 is the number of hours in a year. It should be understood that the values shown by these curves have been taken arbitrarily, and are not intended to represent any specific case, nor should any meaning be attached to the relative costs of steam and hydro-electric plants as shown by these curves.

1. Water Power.—A primary charge of a fixed amount per kw. per year of the maximum kw. plus a fixed rate per kw. hour.

This coincides with the rate basis referred to. The maximum is taken as the average of the ten highest fifteen minute averages occurring during the year.

2. Steam.—Same as 1, except that the maximum is determined as follows: The highest one hour average of every peak throughout the year is noted, and the highest average that can be obtained by averaging any six consecutive peaks is taken as the maximum.

3. Steam.—Different rates per kw. hour specified for various load factors. Such a basis of rates could be fixed for the steam plant illustrated in the curves by specifying the costs per kw. hour shown on curve C, Fig. 2, for various load factors, plus a profit.

This form of rate could be reduced to the general form by reducing curve C, Fig. 2, to curve C, Fig. 1, and separating this into curve A, Fig. 1, and B, Fig. 2.

4. Water Power.—A fixed rate per horse-power per year times the maximum one hour peak. Such a rate is reasonably equitable for a water power plant. It would be quite so if curve F, Fig. 1, were horizontal; that is, if all expenses were fixed.

5. Water Power.—A reservation charge of a fixed rate per horse-power of motors connected per month, plus a fixed rate for power per kw. hour.

This offers no inducement to the purchaser to improve his load factor, as would be the case were the reservation charges based on the maximum load instead of the rated capacity of motors installed. It is not fair to those customers who operate a number of motors, each of which may at times operate up to its rating, but where the simultaneous operation of all of the motors at their rated capacities would never occur.

6. A Fixed Rate per Kw. Hour.—This rate is not a just one, as no consideration whatever is given to the customer's load factor.

7. Steam.—$0.15 per kw. hour for the first 30 hours of the maximum demand, plus $0.10 per kw. hour for all in excess of the first 30 hours' use per month of the maximum demand. This is equivalent to:—

(1) The maximum kw. x 30 hours at 15c. per kw. hour, plus

(2) The total kw. hours minus (the maximum kw. x 30) at 10c. per kw. hour.

The Wright Demand meter records the maximum amperes (at 115 volts) during the month; (1) then becomes equal to the Max. Amp. x 0.115 x 30 x 0.15 = Max. kw. x 4.5, and the customer's bill is, therefore, 4.5 x Max. kw. plus 0.10 x (total kw. hours — 30 x Max. kw.) = 4.5 x Max. kw. plus 0.1 x total kw. hours — 3 x Max. kw. = 1.5 x Max. kw. plus 0.1 x total kw. hours; or, in other words, he is billed at $1.50 per month per kw. of the maximum peak plus a charge of 10c. per kw. hour, which is the same as the general form of rate referred to.

8. Water Power.—A reservation charge of a fixed amount per kw. per month times the maximum kw. plus a charge for power made up of a fixed amount times load factor times maximum kw.

If such a rate were adopted for the water power plant illustrated by the curves, the reservation charge should be approximately $2.79 per kw. per month

$$= \frac{\$25.00 \text{ per H.P. per year}}{12 \times 0.746}$$

the figure $25.00 being taken from curve D, Fig. 1), and the monthly charge for power would be $5.00, plus a profit times load factor times maximum kw. The figure $5.00 is the variable expense per horse-power per year at 100 per cent. load factor as illustrated by curve E, Fig. 1. The company's revenue would have been the same if their monthly power charge had been made equal to $0.00076 per kw. hour, plus a profit times the number of kw. hours' output for the month, since the figure $0.00076 is taken from curve E, Fig. 2, which gives the equivalent costs per kw. at various load factors of the costs per horse-power per year shown by curve E, Fig. 1.

Hence, this rate is directly reducible to the general form of rate previously referred to. The maximum in this case is arrived at by taking the average of the maximum two minute peaks for all the days in the month.

It is evident from the above that the equitable basis of rates or its equivalent offers an inducement to the purchaser of power to improve his load factor. The battery application that I have been leading up to is that of a storage battery installed by the purchaser of power to reduce his maximum demand, and consequently his annual primary charge. From his point of view, the battery proposition to be attractive

must insure him a reduction in his annual power bills sufficient to pay the annual fixed charges and expenses incident to the battery, plus a fair return on the battery investment; or, in other words, the yearly fixed charges and operating expenses per kilowatt of the battery (meaning the total annual cost of the battery divided by the maximum number of kilowatts cut off the peak), must be less than the fixed charges and fixed expenses per kilowatt per year of the power company.

The power company's method of determining the peak has a distinct bearing. For instance, if the peak load of a railway is assumed to be the maximum one hour average load in one case, and the maximum five minute average load in another, the same size of battery might meet both conditions, and, therefore, cost the same, but it could reduce the peak more in the latter than in the former case, thereby effecting a larger return on the investment.

The power company's method of determining its fixed charges per kw. is also pertinent to the battery situation. In the case of a steam plant these charges can often be based on the overload rating of the generating units, while with a hydro-electric plant they can figure on very little, if any, overload capacity, as the generator would probably be installed with a continuous rating nearly equal to the water wheel capacity. If the charges are based on overload ratings, the reduction of a certain amount in the peak would result in less reduction in the consumer's bills than if based on continuous ratings.

In conclusion, I would say that I have only attempted to point out in a necessarily brief way a just basis or form of power rate, and the discussion of such kindred subjects as off-peak loads, wholesale rates to large users, etc., are hardly within the scope of this paper. Local conditions may arise, and do arise, in specific cases necessitating some departure from this general form, but the fact remains that the nearer rates in force approach this basis the more equitable they become.

## RAILWAY ACCIDENTS FOR SEPTEMBER.

### Record for Month Shows Improvement in One Direction.

So far as passengers are concerned, signs of a welcome improvement are noticeable from a glance at a record of the accidents which occurred on Canadian steam railways during September. It is worthy of note that not a single passenger was killed, while only five were injured. This is gratifying. But the figures which relate to employees do not compare with the record for August nearly so favorably. The totals for the two months are as follows:—

| | Passengers | | Employees | | Others. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| 1909 | K. | I. | K. | I. | K. | I. | K. | I. |
| September .... | 0 | 5 | 18 | 15 | 15 | 7 | 33 | 27 |
| August ..... | 4 | 5 | 6 | 8 | 22 | 2 | 32 | 15 |
| Difference .... | —4 | 0 | + 12 | + 7 | — 7 | + 5 | + 1 | + 12 |

It should be possible to prevent many of the accidents to employees. Five brakesmen lost their lives by falling from freight cars, two deaths were caused by defective equipment, and four men were killed while shunting operations were in progress. There is much room for improvement in this direction. Fourteen of the accidents, due to trespassing, could have been avoided. Five persons were killed at grade crossings. Here is the month's record for the steam railways:—

| Character of Accident | Passengers K. | Passengers I. | Employees K. | Employees I. | Others. K. | Others. I. | Total. K. | Total. I. |
|---|---|---|---|---|---|---|---|---|
| Derailment | .. | .. | 2 | .. | .. | .. | 2 | .. |
| Head on Collision | .. | .. | .. | 1 | .. | .. | .. | 1 |
| While Shunting | .. | .. | 4 | .. | .. | .. | 4 | .. |
| Highway Crossing | .. | .. | .. | .. | 5 | 3 | 5 | 3 |
| Fell off Freight Cars | .. | .. | 5 | 6 | .. | .. | 5 | 6 |
| Trespassing | .. | .. | .. | .. | 10 | 4 | 10 | 4 |
| Pitch in with hand car | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Adjusting Couplings | .. | .. | .. | 2 | .. | .. | .. | 2 |
| Passengers falling off | .. | 2 | .. | .. | .. | .. | .. | 2 |
| Working on track | .. | .. | 2 | .. | .. | .. | 2 | .. |
| Attempt to board moving train | .. | 1 | .. | .. | .. | .. | .. | 1 |
| Unclassified | .. | .. | 1 | 1 | .. | .. | 1 | 1 |
| Working on Cars | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Suicide (attempted to) | .. | 1 | .. | .. | .. | .. | .. | 1 |
| Side ladders | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Jumping off train | .. | 1 | .. | .. | .. | .. | .. | 1 |
| Collision (rear end) | .. | .. | .. | 1 | .. | .. | .. | 1 |
| While Switching | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Working under cars | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Struck by switch stand | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Locomotive Explosion | .. | .. | 2 | .. | .. | .. | 2 | .. |
| Totals | 0 | 5 | 18 | 15 | 15 | 7 | 33 | 27 |

### In the United States.

Railway loss and damage claims and injuries to persons cost the railway companies of the United States $56,700,000, according to statistics collected by Mr. Slason Thompson of the Chicago bureau of railway statistics. This is an increase of nearly $10,000,000 over the amount paid in 1907, while ten years ago, in 1898, the payments were only $12,182,000. These payments now absorb nearly 2% of the gross earnings. In some sections the damage claims are much heavier than in others. In Texas, in 1908, 5.19% of the railways' revenue went to pay claims for losses, damages and injuries to persons. In Pennsylvania alone, 26 were killed and 109 injured in six months, at grade crossings.

The statistics for the electric, which we give below, for August and September, are not so encouraging. Comment is unnecessary:—

| | September, 1909. Killed. | Injured. |
|---|---|---|
| Run over | 1 | 5 |
| Fell off | 3 | 7 |
| Struck | 2 | 7 |
| Derailment | — | 2 |
| Attempted suicide | — | 1 |
| Alighting from moving car | 1 | 4 |
| Attempting to board moving car | — | 3 |
| Collisions | — | 3 |
| | 7 | 32 |
| August '09 totals | 3 | 27 |

Recent action of the Winnipeg Board of Control is to be commended. Following the death of the victim of a street car accident, they asked the provincial government to take up the question of compelling the use of the most modern fenders and wheel guards on all street cars in operation in the province of Manitoba. It is the opinion of the board that the frequency of fatal accidents and accidents which inflict grievous bodily injury calls for radical measures to be taken.

(Continued on Page 411.)

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THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## FILTRATION FIRST, STERILIZATION SECOND.

Apropos of the position which this Review has taken up, "That sterilization cannot be looked upon as a complete method of purifying water, but only as a supplementary method," it may be well to note what has been done at Chartres, France, in connection with an ozone treatment plant recently installed.

The town of Chartres depends for its water supply upon the River Eure, this being a polluted source. The plant has a capacity of 1,600,000 gallons per day.

The sterilization of one cubic metre (265 gallons) of water requires 370 litres of air containing 5 10th milligram of ozone per litre. A little more than two grams of ozone are required, therefore, for each cubic metre of Eure water treated. The raw water contains about three milligrams of organic matter per litre.

The water, before it is subjected to the above sterilizing influence, is first treated by an elaborate system of sand filtration. There are ten sand filters, 6 by 7 metres, with a sand bed one metre thick, supported on iron grills, which allow the escape of the water and facilitate mechanical cleaning of the filters. The capacity of these filters is about 15 to 20 cubic metres per square metre of filter surface per day. Before reaching the sand filters the water passes through biological filters filled with coke, two of which precede each sand filter, and are operated alternately. In them the water is subjected to a nitrifying action, and about 80 per cent. of the bacteria are removed. The first cost for the filter plant amounts to 25 francs ($5.00) per cubic metre of water treated per day, while the first cost of the combined filter and sterilizing plant totals 50 francs per cubic metre per day.

Referring to a pamphlet recently published by the "United Water Improvement Co., Philadelphia," entitled "Ozone in Water Purification," we find the opening remarks as follows: "The city of Paris, after many years' experience with sand filtration, has recently adopted a process of purifying its water supply, derived from the Marne River, by means of electrically produced ozone. This decision has been reached after ten years of careful experiments, in which ozonization has been placed in competition with filtration in all its forms."

Now, the natural conclusion which anyone would deduct from the above statement must only be that sand filtration is a defunct process in Paris, and is superceded by ozone treatment.

If we read a little further on in the pamphlet we find another statement as follows: "The ozone purification plant has been planned to treat 24,000,000 gallons a day of water which has hitherto been imperfectly purified by an elaborate system of slow sand filtration at St. Maur, a suburb of Paris."

Surely the meaning which this sentence is intended to convey is that ozonization is planned to supersede and replace the slow sand filtration plant.

At the top of page 5 of the same pamphlet we read also that "Recent improvements in the art . . . have brought the cost of ozone purification far below that of either slow sand filtration or mechanical filtration." Indeed, the difference in favor of ozonization is now so great that if costs alone were the chief consideration no community would be justified in spending the enormous sums of money required to treat public water supplies by any of the old methods."

Here, again, one system is quoted as in competition with the other, and the inference to be drawn is that it is a question of choice between filtration and sterilization.

Let us turn, however, to the "Journal of the Royal Sanitary Institute," February, 1909, and quote from Dr. Samuel Rideal, page 48: "The Paris municipality have decided to ozonize the whole of their Marne supply at St. Maur, equal to 90,000 cubic metres per day. The water to be treated will pass through the existing filters at twice the present rate."

We find, therefore, that this ozone treatment is not intended to supersede the sand filtration, but to merely form an adjunct.

It is admitted on every hand that, although sand filtration may arrive at near perfection, one hundred per cent. efficiencies are not obtained in bacterial removal, and that sterilization can only be relied upon for absolute purification. It is not sufficiently admitted, however, that sterilization only becomes possible after thorough filtration, and to be effective the two processes must go hand in hand. It is not a question of comparison of efficiency between the two processes. Those who for trade or other purposes are taking up this position are doing more harm to the problem of sterilization than open antagonists to the whole principle.

In the London "Times" (Engineering Supplement), August 4th, 1909, a chemical correspondent concludes an article on "Ozone for Water Purification" with the remark: "It should not be inferred from these observations that the adoption of the ozone process will abolish the necessity for the use of filter beds."

As a matter of fact, purification by ozone does not affect the turbidity of water, this remaining constant.

In the case of the tests made by Mr. A. E. Walden at Baltimore ("Engineering News," March 18th, 1909), with 50,000 bacteria per c.c., 98.85 per cent. were removed, there being 680 bacteria per c.c. in the raw water. The turbidity of the raw water is given at 400 and the turbidity of the ozonized water at 100. An explanation of the poor result of this test has been given that it is no indication of what ozone can accomplish with a clear but bacterially impure water.

Here we have it all in a nutshell. Suspended matter must be first removed before it is practical to sterilize water with any degree of efficiency. Removal of suspended matter can only be obtained by sedimentation in storage with or without coagulants or by straining through filters.

We are constantly being asked the question: "Which is the best, ozone treatment or filtration?" Our answer is, without doubt the first duty of any municipality is to provide efficient filtration of water first, and if sterilization is required as an extra safeguard, only then can it be considered as a method of further treating the filtered water to kill off, if possible, any of the few bacteria remaining.

## AUTUMN AND TYPHOID.

The autumn and early winter seasons are more associated with typhoid epidemics than any part of the rest of the year.

Typhoid in many places is practically endemic; that is, the germ of infection is always present. Given the suitable conditions for the spread of the germs, the disease, if not closely watched and guarded by quarantine laws, becomes epidemic.

It may be possible in some instances to determine the cause of the beginning of an epidemic, by means of milk or water coming in contact with excreta, or some other defined cause. The continuation of an epidemic is generally due to want of care in isolating a patient, and a lack of knowledge of the proper precautions to take in preventing the spread of infection.

A list of instructions issued by the Saskatchewan Government for the public guidance in the form of a leaflet is well worth consideration and practical attention:—

### Instructions in Cases of Typhoid.

1. Typhoid fever is contracted solely by the mouth. If you do not put the poison of typhoid fever into your mouth you will never contract typhoid fever. Therefore, watch the mouth.

2. Do not eat or drink anything (water, milk, oysters, fresh vegetables or anything else) unless it has been first boiled, broiled, baked, roasted, fried or otherwise thoroughly heated through and through.

3. Do without all food or drink which has not first thus been heated. (Canned or bottled foods or drinks, other than milk or water, are not included in this.)

4. If living in the same house with a typhoid fever patient, do not handle your own food, or food intended for anyone else, even if it has been heated, except with hands that have been thoroughly washed with soap and very hot water. (Preferably also with antiseptics—ask your physician about the antiseptic to use.) Wash before every meal in this way and before cooking, serving or eating anything or putting the fingers in the mouth.

5. If there are flies about, see that all food and drink is protected from them at all times. Flies often carry typhoid poison to foods and drinks.

6. The poison of typhoid fever does not show itself for two weeks after it enters the body. Therefore, for the next two weeks typhoid cases may develop from typhoid poison already taken in. But any case which develops on or after.....will be due solely to neglect of this notice and failure to carry out minutely the directions here given.

## SEWAGE DISPOSAL.

### Removal of Putrescibility.*

Chapter VII.

### Percolating Filters.

In the issue of September 24th, it was concluded that certain points must be observed in order to obtain the maximum efficiency in purification of sewage by means of percolating filters.

The points noted were:—

(a) Even distribution of the sewage over the whole surface of the filter.

(b) That the sewage be not presented in the form of bulk, but broken up into drops or spray.

(c) The porosity be of open character, that the drops of sewage will not fill the pores to the exclusion of air.

(d) That the passage of the drops of sewage through the filter be sufficiently slow, to give ample time for the absorption film to extract from each drop of sewage, the organic impurities contained.

(e) That the liquid supplied to the filter never be under pressure, beyond the gravity inherent to each independent drop, so that there is no flushing of the filter.

We will now proceed to deal with the above points in the order named, and leave the important subject of the effect of frost and protection from frost for subsequent consideration.

### Even Distribution.

Under this heading the points (a) and (b) will be dealt with together.

It has been previously pointed out that the contact bed was the result of an effort to get over the difficulty of even distribution. Even distribution was obtained by filling the contact bed to the point of saturation, that is the sewage was presented in the form of bulk to the exclusion of air. This produced conditions unfavorable to nitrification, air being necessary to this fermentative process.

A number of devices have been brought out with a view to solving the difficulty of even distribution, combined with the view of presenting the sewage in the forms of drops or spray. Generally speaking, these devices partake of two forms, either as fixed sprays, or revolving sprinklers.

Outside these two main divisions, sewage has, on a small scale, been distributed by means of perforated corrugated iron troughs, and by means of automatic tipping tanks. In the latter connection, the Fifth Report of the Royal Commission on Sewage Disposal states, "Tipping troughs and dripping trays are, in our opinion, more suitable for small

*These articles are specially prepared for this Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

than for large installations. They can adapt themselves to large variations of flow, and in the case of small or medium-sized works, where constant supervision is not available, this is a great advantage. We may add that these trays are better suited for the distribution of a large volume of weak liquid than a small volume of strong liquid.

"The distribution is seldom perfect by either of these forms of distribution, and consequently it is advisable to have deep beds where they are adopted. Further, owing to the fact that the delivery of liquid in both cases is more or less constant, medium-sized or coarse material should be used, to prevent ponding.

"A certain amount of supervision is necessary as a tray may become blocked or a trough may fail to tip."

The above conclusions appear to be fair, apart, however, from the classifying of drip trays along with tipping troughs. Drip trays have, to our knowledge, proved satisfactory in many small installations, when the tipping trough has failed. The best form of drip tray is that invented by Mr. F. Wallis Stoddart, which will be understood from the accompanying sketches The distributor consists of corrugated sheet-iron plates laid evenly over the surface of the bed in the form of

Stoddart's method of distribution came into vogue in 1898, and was preceded by a somewhat similar method adopted at Salford, (England), by Corbett, the city engineer, who conceived the method of leading sewage into percolating filters by means of wood troughs or channels placed about 3 feet above the filters, the sewage overflowing the troughs and splashing in the surface of the filters. Corbett, however, replaced his distributing troughs by fixed perforated pipes, through which the sewage was discharged periodically by aid of a syphon. This is really the parent of the fixed spray principal. It was not long before Corbett improved the form, resulting in the fixed fountain spray (which has become known as the Salford spray), and adopted by Watson, if Birmingham, on a large scale, at Columbus, Ohio; and at Hamilton, Ontario; etc.

The fixed spray necessitates a working head of from two to eight feet. The sewage is distributed from a collecting tank, (after the solids have been removed), by pipes either placed on the surface of the filter or within the bed of the media. From these pipes perpendicular junctions, pieces are led to above the surface of the bed, terminating with a spray nozzle. The sewage is emitted from the nozzle

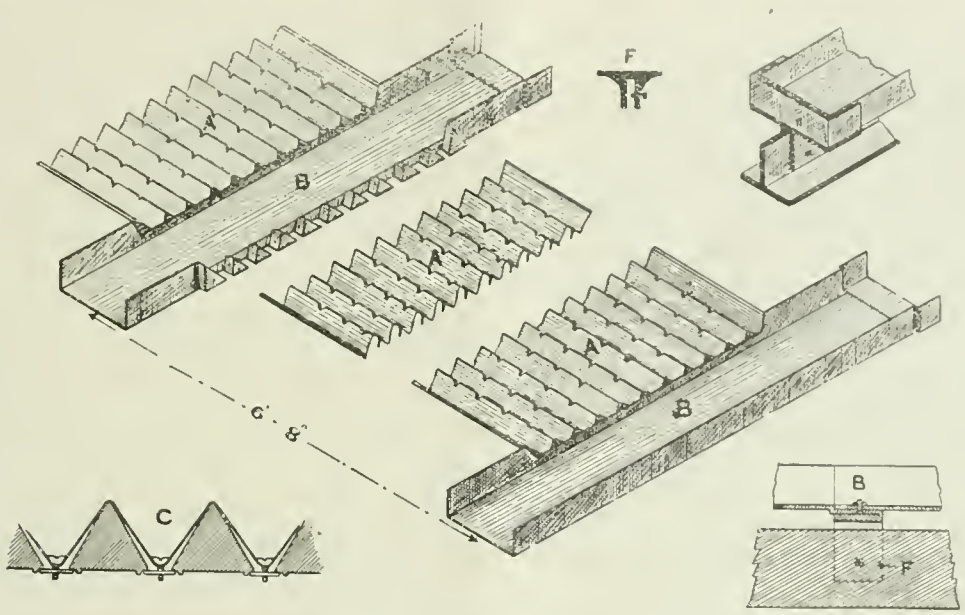


**FIG. I.—SKETCH OF THE STODDART SEWAGE DISTRIBUTOR (PATENT).**

A—Distributor.
B—Supply Channel
C—Attachment of Distributor to Channel.
F—Chair with Set Screw.

channels with perforations on top. On the lower face of the channelling there are placed at intervals projecting points from which the liquid drops to the surface of the bed.

Messrs. Galt and Smith (Engineers, Toronto), have recently installed the above method of distribution in connection with a biological filtration plant at Vernon, B.C. They claim that its chief advantages apart from distribution are,—no moving parts which can be affected by frost, and that in the case of a small installation, it can be readily covered in and protected. There is no doubt that the simplicity and effectiveness of the method recommend themselves for small beds. In the case of large works, however, difficulty is encountered in laying the channelling evenly, and maintaining the proper levels, so as to prevent overdosing at certain points to the exclusion of others. The system has been successfully applied at numerous country houses, and private and public institutions, but has had no wide adoption in the case of larger works.

by virtue of the head pressure in the form of a circular fountain spray. The surface of the filter presenting any number of these circular sprays as arranged. Usually the filter beds are arranged as squares or rectangles, and each separate spray being a circle, the intervening space between each circle receives no sewage, consequently a large area of the filtering material is continually out of use.

Further, in spite of all efforts to vary and improve upon the form of nozzle, an even and equal distribution of sewage over the surface, contained in the circle area has been found impossible.

The fact that there are no moving parts connected with the fixed spray has led the Massachusetts Board of Health t. make a number of experiments in this direction; it being thought, that, where it is a question of frost, the fixed spray presented advantages over the revolving sprinkler. In this connection we would quote the conclusions arrived at, published in 1907, State Board of Health Report.

"From the experiments with the sprinklers it is seen that, while the mean rate upon the area wet may be kept down to the point where good purification is assured, small portions of this area are receiving the bulk of the sewage at rates many times greater than practical, while the larger portion of the filter is being operated at a very low rate. The result is that a considerable proportion of the sewage may pass through the filter practically unchanged, and a small portion be highly purified; in other words, the effluent from the filter may be a mixture of highly purified effluent and of practically unpurified sewage, rather than a uniformly purified effluent."

"The sprinkler tests have shown that, as the head is increased, the size of the area covered by any sprinkler, and the rate of discharge by the sprinkler increase, but that, the mean rate on the area wet diminishes. These tests have shown, also, that nearly all sprinklers are more efficient in producing uniform distribution when operated at the higher heads, and that only a small variation in this efficiency is produced by elevating the sprinkler above the surface. The rates obtained with nearly all of the sprinklers have been so large that they could not be operated continuously without causing the filter to be flooded at much higher rates than are

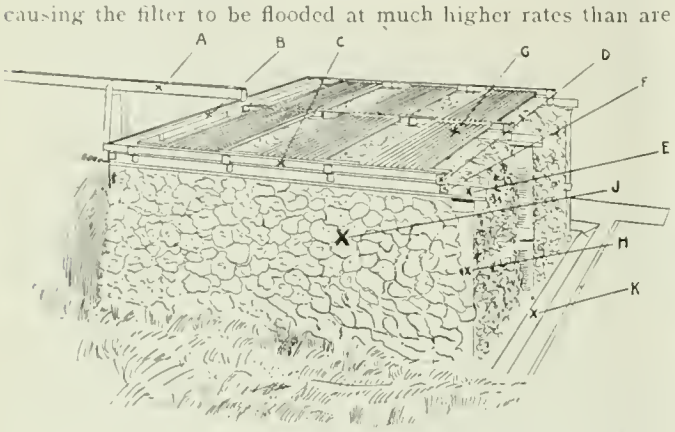


**FIG 2.—KEY TO PARTS OF THE STODDART SEWAGE FILTER.**

A—Feed Channel from Tank. F—Chair with Set Screw.
B—Main Channel G—Distributor.
C—Supply Channel. H—Pier.
D—Stopend or Penstock. J—Filter Body (clinker).
E—Iron Tee. K—Collecting Channel.

at present believed to be advisable; and for this reason a system of distribution by sprinklers of any of these types should also include some device for producing intermittent operation. Operating the sprinklers under variable head has resulted in wetting the portion of the surface adjacent to the sprinkler which was entirely overthrown by the same sprinkler under constant head; but this more complete wetting has not resulted in any material increase in the uniformity of distribution, since a greater volume of sewage is concentrated upon a smaller overdosed area."

The Royal Commission dealing with the above question have to state (page 92, 5th report), "Distribution by means of perforated pipes or nozzles laid over a filtering area is almost always rather unequal, and this would be a disadvantage, except in the case of fairly deep beds, constructed of fine or medium material, or deep beds, (say eight feet or more), of coarse material. This method of distribution, moreover, needs a considerable head of liquid for proper working, and also requires constant attention to keep the pipes and distributing holes clean and free. At Birmingham, where the nozzle form of distributor is in use on a large scale, for each acre and a half of filter, one man is constantly employed night and day in cleaning nozzles."

(To be Continued).

## THE ELECTRIC FURNACE AT DOMNARFVET. SWEDEN, ETC.*

**By Eugene Haanel, Ph.D. (Director of Mines for Canada).**

In the winter of 1905-6, a series of experiments in electric smelting were conducted at Sault Ste. Marie, Ont., under the auspices of the Dominion Government, with the object of establishing the feasibility of economically smelting Canadian magnetic iron ores comparatively high in sulphur, but free from manganese; and using charcoal as the reducing agent.

As a result of these experiments, the electro-metallurgy of the reduction of refractory iron ores without the use of coal or coke fuel was established; and—as far as could be expected from a small, experimental furnace—the output of pig iron per electrical horse-power-year, determined. Moreover, based upon the experience thus gained, certain fundamental changes and improvements necessary in the construction of an economic electric furnace in the future were

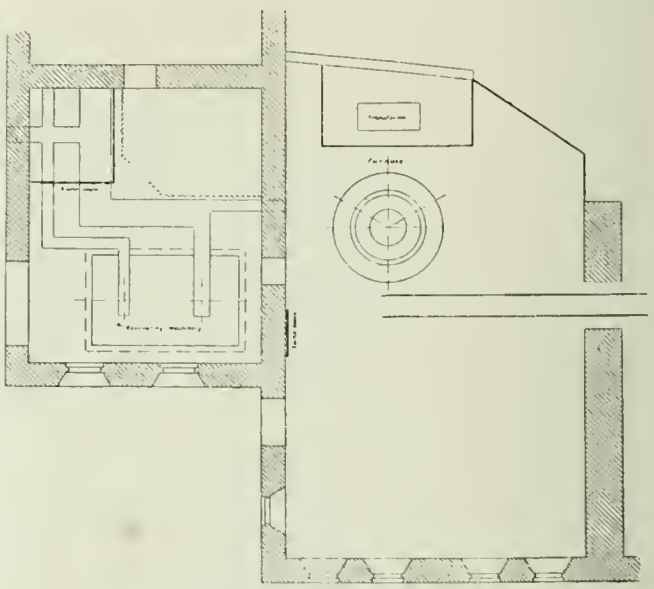

**Fig. 1.—Plan of Electric Smelting Plant.**

suggested, in order to render it suitable for the production of pig iron on a commercial scale.

Although the Canadian experiments of 1905-6, proved entirely successful as regards the special objects aimed at, and while considerable interest in the reduction of iron ores by the electro-thermic process was manifested at the time, no additional experimentation of any significance has been undertaken in Canada, along the line suggested in the Mines Branch report, to ensure the commercial success of electric smelting. In Sweden, however, where the conditions governing the economical use of the raw materials necessary for an iron industry are very similar to, and in many respects identical with, those existing in several of the provinces of the Dominion of Canada, the importance of an economic, commercial, electric smelting process was fully realized by three young Swedish engineers some two years ago. These engineers, viz., Assar Grönwall, Axel Lindhlad, and Otto Stalhane—stimulated by the successful results of the work done at Sault Ste. Marie—undertook to solve the problem of designing and constructing a commercial electric furnace.

* Report to the Department of Mines, Canada.

Inasmuch as the electro-metallurgy of the reduction of iron ores had been established by the Canadian experiments, these Swedish inventors concentrated their entire efforts in an attempt to solve the practical, commercial problem, along the lines suggested in the official report. In carrying out their plans to a successful issue, they were ably assisted by the ironmasters of Sweden, who manifested great interest in this question. Special assistance was rendered by the able, and far-sighted director, E. J. Ljungberg, and the vice-director, Lars Yngstrom, of the largest and most influential industrial company in Sweden, the Stora Kopparbergs Bergslags Aktiebolag. The inventors made an agreement with this company, and the Trafikaktiebolaget Grangesberg-Oxelösund (owners of the largest iron ore deposits in Sweden), to carry on smelting experiments on a large scale at the Domnarfvet Ironworks.

In order to concentrate their individual attention on this problem, the inventors formed a company called the Aktiebolaget Electrometall, to which the patent rights were assigned.

### Evolution of the Electric Shaft Furnace.

The construction of the specially designed electrical machinery, and the preliminary work necessary for the construction of the furnace, were commenced in April 1906; and

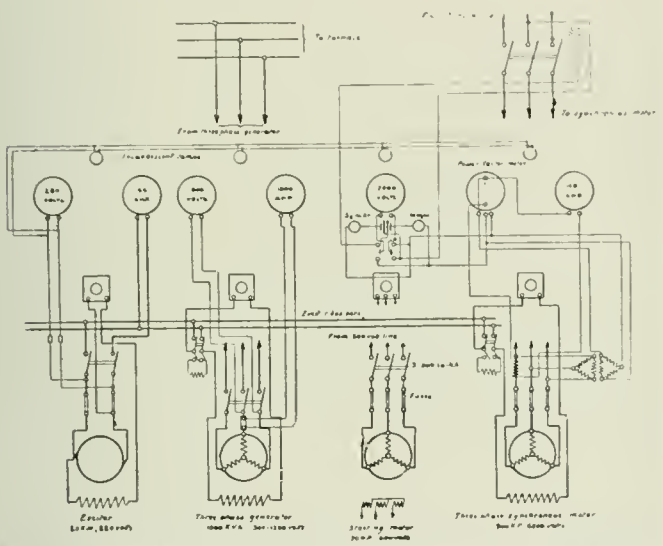

**Fig. 2.—Diagram of Switchboard Connections in Generating Station.**

towards the end of that year—when the installation of the electrical machinery and high-tension cables, etc., was completed the construction of the first electric shaft furnace was begun.

This furnace was put in operation April 1907, and from that time experiments were continuously carried on and improvements made; the daily experience thus gained being utilized in successive changes in design and reconstruction towards perfection. All experimentation was conducted along scientific lines, and has yielded a rich fund of usable knowledge and instructive data as follows:—(1) On the construction and operation of electrical furnaces; (2) on the conductivity and other characteristics exhibited by materials when subjected to high temperature; (3) on the qualities of the refractory lining materials; and (4) on the most suitable manner of designing and constructing the masonry of the furnaces. In addition to this, different methods of supplying the current and of various contact devices, etc., were tried and tested. In these initial steps the experimenters did not confine their entire attention to the practical side of electric smelting, but carried on laborious researches and investigations concerning the solution of purely theoretical problems, and the determinations made and data gathered will doubtless form an important contribution to the electro-metallurgy of iron and steel.

Taking into consideration the fact that the inventors have signified their intention of writing a detailed account of all the experiments conducted by them during the past three years, it will be unnecessary for me to enter into minute details; but to set forth only such facts as have a direct bearing on the experimental trials witnessed at Domnarfvet.

With a view of elucidating a number of disputed technical points involved in the smelting process itself, initial experiments were conducted at Ludvika during the summer of 1907, with a small furnace of 300 horse-power capacity. During these preliminary experiments many difficulties were encountered which had to be overcome; and it was not until the summer of 1908 that they succeeded in designing and constructing a furnace which, in their opinion, could be economically used in practice. Towards the end of the summer a number of experiments were made with this furnace, which demonstrated that the type evolved was durable, and that a good output could be obtained therefrom, notwithstanding the fact that the furnace was constructed with a relatively low shaft in order to reduce the building expense. On account of this low shaft, which was open at the top—as in the case of the furnace employed at Sault Ste. Marie—the consumption of charcoal was large, viz., 9 cwts. 6 lbs. per metric ton of pig iron produced. A considerable portion of this charcoal was consumed at the top of the open shaft, and the gas escaping from the furnace consisted almost wholly of carbon monoxide. Hence, notwithstanding the excellent results obtained with this furnace, the inventors conceived that by utilizing the waste gases, even more economic results could be attained; they consequently decided to construct a new one of larger capacity, with a higher and more rationally designed shaft.

The new furnace was completed early in December 1908, and the intention was to at once begin an extended trial run; but owing to a severe drought this extended trial had to be postponed. Some time previous to the completion of this furnace the inventors tendered the writer an invitation to witness a short trial test to take place early in December. Although little rain had fallen up to this time, hopes were entertained that by the middle of December there would be sufficient water to carry on the contemplated experimental trials.

Soon after receiving the invitation, I received official instructions to proceed to Sweden to investigate and report upon this new electric shaft furnace, and sailed for Europe via New York, on November 25, 1908. Immediately on my arrival in Stockholm, where I met Mr. Grönwall—one of the inventors of the furnace—it was arranged that we should go to Falun for the purpose of placing before Mr. Ljungberg, the general director of Stora Kopperbergs Bergslags Aktiebolaget—at whose works the furnace was erected—the great importance to Sweden, as well as other countries, of making, if possible, the contemplated special trials. As a result of this conference, he very generously allowed the use of power to operate the furnace for twelve days. The inventors informed me, however, that they did not expect entirely satisfactory results as regards the output of pig iron per electrical horse-power year, since a furnace of this size could not possibly arrive at its normal working condition in the short time allowed for the test inasmuch as the walls are so thick

that it takes a comparatively long time to heat them entirely through; and acceleration of the heating could only be accomplished at the risk of damaging the furnace walls. In addition to this, the shaft should not be filled to the top until after several days' working.

In concluding this preface, it may be mentioned that the experimental trials witnessed were not conducted for the purpose of determining the output of pig iron per electrical horse-power year—this had been satisfactorily determined by the experiments at Sault Ste. Marie, as well as by the Swedish inventors in their experiments with the furnace preceding the one investigated at Domnarfvet—but to demonstrate the commercial feasibility of the furnace, and to prove whether uniform working without disturbance could be expected.

### Description of the Plant.

The experimental plant (Fig. 1) was installed in an old building adjoining the basic-Bessemer converter house. The machinery, which was specially designed and constructed for the experimental trials, consists of a three-phase synchronous motor of about 900 horse-power, supplied with a current of 7,000 volts, and 60 periods, from a three-phase cable line in the ironworks. This motor is directly coupled to a three-phase generator, which supplies current of 25 periods, adjustable to between 300 and 1,200 volts, through small intervals to the transformers erected in the immediate vicinity of the furnace. By means of this extensive regulation it is possible to determine the most suitable voltage to be employed with furnaces of different construction, and operating under various conditions.

The fields of both the synchronous motor and the generator are fed with current at a tension of 220 volts, from a direct-current generator of 20-kw. capacity, directly coupled to the system. For starting the system a three-phase synchronous motors, directly coupled is employed. This is fed with a current stepped down to 500 volts. The arrangement for controlling the machines may be seen from the coupling scheme shown in Fig. 3.

From the switchboard the current is conducted through copper bars, laid in cement channels, to the three-phase transformers. The capacity of these transformers is 1,500 K.V.A., and their ratio of transformation 14: 1. By regulating the tension of the generator, the low tension sides of the transformers can be altered, through small intervals, from 20 to 85 volts. The ratio of transformation can be altered to 7: 1 by means of certain easily performed changes of coupling in the transformers; in which case the low tension can be varied between 40 and 170 volts. The transformers are cooled with air supplied under pressure by two electric blowers. A switchboard is situated conveniently near the furnace for controlling its operation. On it are mounted the following instruments:—One three-phase precision wattmeter for differently loaded phases; three ampere meters—one for each phase, and one voltmeter. The ampere meters, and the wattmeter, are connected to the current system by means of transformers. The voltmeter and tension terminals of the wattmeter are directly connected to two of the conducting bars.

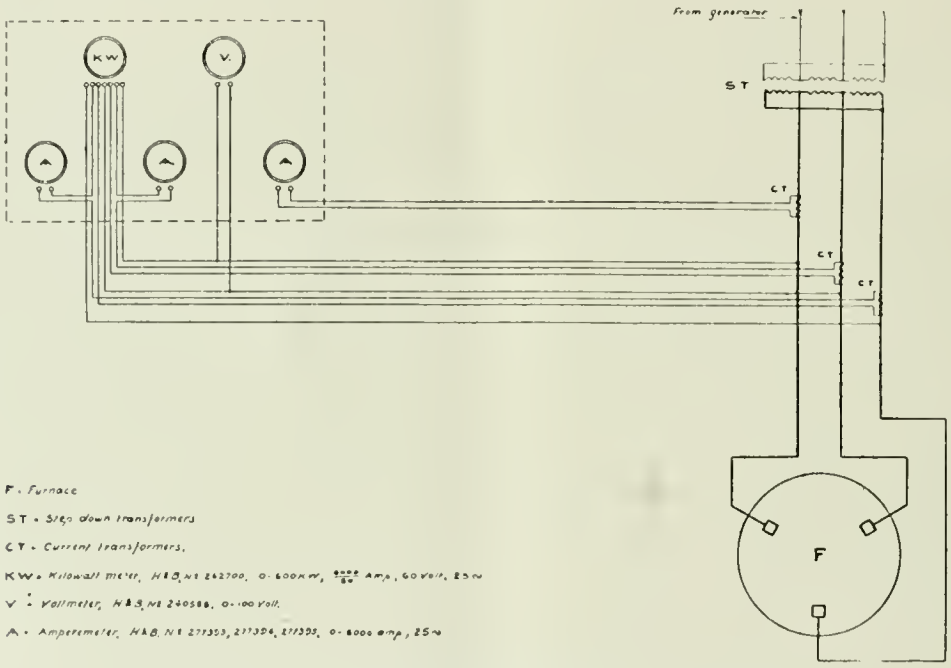


**Fig. 3.—Diagram Showing Connections of Instruments Controlling the Furnace.**

To protect these instruments from heat when tapping, an iron curtain, which may be lowered or raised, is placed in front of the switchboard. The connection of the instruments is shown by the connection-diagram, Fig. 3; while the external appearance of the arrangement is shown by the photograph, Fig. 4. It will be seen that the wheels—by which the electrodes are adjusted—are placed under the instruments in such a manner that the wheel and ampere meter opposite to each other belong to the same phase.

### Description of Electric Furnace.

In general appearance this electric shaft furnace is unlike any hitherto constructed, being very similar in design to an ordinary blast furnace, in which the tuyeres are replaced by electrodes.

A vertical section of the furnace is represented by Fig. 5; and Fig. 6 shows a plan with the shaft and electrodes removed. The height of the furance above ground level is about 25 feet. The melting chamber or crucible containing

the electrodes is about 7 feet high, and is of greater diameter than any other part. The shaft is about 18 feet high, the lower end of which—for about 4 feet—has the form of a truncated cone; for the purpose of directing the charge into the crucible in such a manner that the electrodes, lining, and descending charge, could not come in contact. This special feature in the design was introduced by the inventors after repeated experiments, which demonstrated that the upper surface of the column formed by the materials charged into the furnace assumes a definite angle, viz., 50 degrees to 55 degrees to the vertical, when the materials—crushed to normal size, and at the same temperature as that existing in the melting chamber—are allowed to fall through a circular aperture into a free space. In Fig. 5 the slope is indicated by dotted lines.

It is this isolation of the descending charge from the lining at the point where the electrode enters the furnace that constitues the particular economic advantage of the construction, since it prevents the destruction of the lining, which occurred in all previous furnaces where the electrode came directly in contact with the melting charge and the lining; for the temperature of the brickwork in close proximity to the electrodes becomes so great that the most refractory lining materials are rapidly destroyed—even when the electrodes are cooled by the water jackets.

The contracted neck of the shaft immediately over the central opening into the melting chamber is not supported by the arched roof, but the entire weight of the shaft is carried by six cast-iron columns arranged symmetrically around the furnace hearth.

The melting chamber is made in the form of a crucible, and is covered with an arched roof provided with openings for the reception of the electrodes and descending charge. The roof and walls of the crucible are lined with magnesite.

For the purpose of cooling the brickwork composing the lining of the roof of the melting chamber, and thereby increasing its life, three tuyeres are introduced into the crucible—just above the melting zone—through which the comparatively cool, tunnel-head gases* are forced against the lining of the roof into the free spaces. This gas absorbs heat from the exposed lining of the roof and walls, and the free surface of the spreading charge, thus effectively lowering the temperature of the roof and exposed walls.

With the exception, however, of radiation from the tuyeres, no heat is lost by this method of cooling or lowering of temperature, since the heat given up by the lining of roof and wall to the comparatively cool gas introduced through the tuyeres, is imparted in passing upward through the shaft to the cooler portions of the descending charge. This effects not only a better utilization of the reducing power of the CO, but in addition, produces a better distribution of heat throughout the charge in the shaft than in any electric furnaces previously constructed.

The tuyeres are provided with sight holes, covered with mica, through which the interior surface of the arched roof can be observed. By means of this device it is possible to determine approximately the necessary quantity of gas required to effectively cool the roof lining at the mouth of the melting chamber.

Each electrode was built up from two carbons 11 inches square × 63 inches long, making the total cross section of the built-up electrode 11 inches × 22 inches. The electrode holder is made of a strong steel frame, forming a support for the wedges by means of which the copper plates conducting the current from the copper cables are pressed against the faces of the electrode. The electrode is clamped in the steel frame mentioned above, and slides on two guides, which serve the two-fold purpose of keeping the angle of inclination to the vertical constant and relieving the arched roof of any undue strain which would arise from the weight of the electrode—if insufficiently supported. A steel cable, secured to the top of the electrode holder and passing over a system of guide wheels or pulleys to the drum operated by the hand-wheel on the switchboard, serves to lower and raise the electrode, by winding or unwinding the drum. In order to protect the parts of the electrodes outside the furnace from the oxidizing action of the air, a suitable covering is provided.

The water-cooled stuffing boxes, through which the electrodes enter the melting chamber, are provided with special devices (not shown on the drawing) for preventing the gas under pressure within the melting chamber from leaking out around the electrodes.

The shaft—as previously mentioned—is supported by an iron plate, resting on six cast-iron pillars arranged symmetrically around the furnace hearth. To prevent the pillars from being cut off in the event of the molten iron accidentally finding its way to them, the lower parts are protected by sand enclosed in a sheet-iron casing. This mode of construction enables the operator to repair or replace—without removing the shaft—those parts of the furnace needing the most frequent repairs, viz., the lower part of the shaft, and the melting chamber.

In order to collect the waste gases at the throat of the furnace—with the object of utilizing them economically for the purposes specified, and at the same time to protect the charcoal fuel from premature combustion—the top of the shaft is closed by an iron cover, fitted with a charging bell and hopper, covered in by means of a specially constructed sheet-iron hood, designed to prevent gas explosions caused by the intrusion of atmospheric air into the shaft when a charge is being introduced.

The collected gases at the throat of the furnace are discharged into a downcomer pipe, provided with a dustcatcher, from which the gases—largely denuded of dust—are drawn by means of a fan, and forced down into the smelting chamber through the tuyeres. With a view of preventing excessive pressure in the interior of the furnace, an uptake pipe—provided with loaded, self-closing valve—is placed at the junction of the outlet pipe and top of downcomer, for conducting the gases generated in the furnace (when the pressure reaches a certain point) to apparatus designed for the utilization of the waste gases, or to the atmosphere.

Raw Materials Used.—The iron ore placed at the disposal of the inventors for the trial run was magnetite from Grängesberg, and had the following compostion:— $Fe_3O_4$, 66.46 per cent.; $Fe_2O_3$, 21.21 per cent.; MnO, 0.30 per cent.; MgO, 0.98 per cent.; CaO, 3.84 per cent.; $Al_2O_3$, 1.07 per cent.; $SiO_2$, 3.16 per cent.; $P_2O_5$, 2.34 per cent.; S, undetermined; metallic iron, 62.96 per cent.

During the first part of the trial run, coke containing 85 per cent. C and 0.55 per cent. S was used. This, however,

* During the run of the furnace now in progress (July 7) an examination of the tunnel-head gases was made, resulting as follows:—The escaping gases were kept (by regulating the circulation) at a temperature of 200° to 300°; and the following is an analysis when using:—

| Hematite: | Per Cent. | Magnetite: | Per Cent. |
|---|---|---|---|
| $CO_2$ ..... | 40 | $CO_2$ ..... | 25 |
| CO ..... | 50 | CO ..... | 65 |
| H ..... | 10 | H ..... | 10 |

had been exposed for a long time to the open air and rain, which made its percentage of moisture unusually high. Lime was used as a flux. The raw material—crushed to pieces of about 1 inch diameter—was conveyed to the charging floor of the furnace, where it was weighed, and charged by hand. The instruments were read every half-hour, the product of each tapping carefully weighed, and samples of both the iron and slag taken for analysis. The iron and slag were tapped through the same hole, but no difficulty was encountered in separating the iron from the slag after cooling. The men operating the furnace were divided into two shifts, each shift being of twelve hours duration, and consisting of four labourers and a foreman.

Heating of the Furnace.—Notwithstanding the fact that the furnace was new in every respect, only one week was

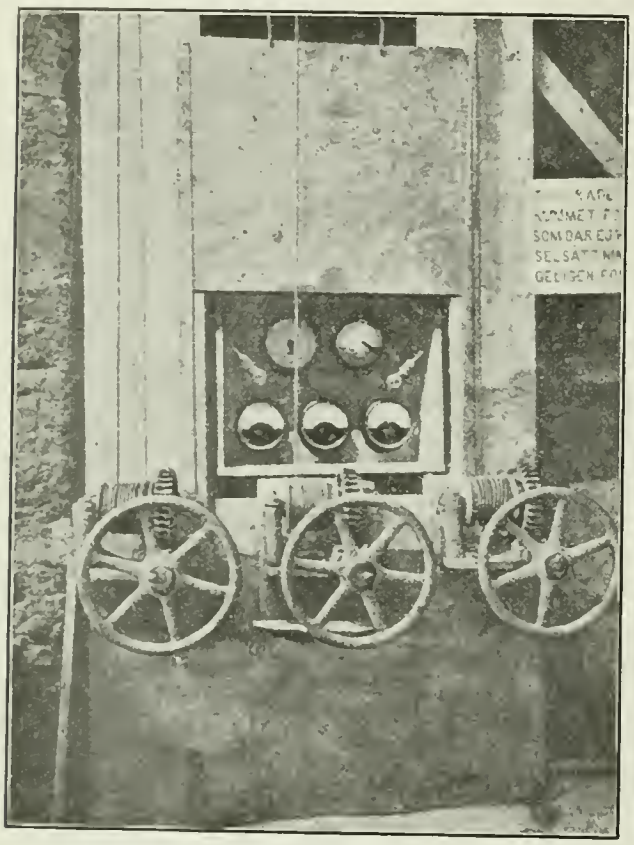

**Fig. 4.—Wheels and Instruments for Controlling the Electrodes.**

allowed for heating from the time the first coke fire was lighted in the melting chamber to the time of the first tapping. Experience with blast furnaces has proved that at least three weeks should be devoted to the drying of the linings in furnaces of this size, prior to charging, otherwise, the heat energy which should be utilized in the reduction and dissociation of the ores will be expended in converting the moisture in the brickwork into steam, resulting in the chilling of the iron, and consequent reduction of the output. The unavoidable neglect of this precaution in the present instance interfered materially with the normal thermal working condition of the furnace throughout the entire trial—especially at the beginning—as the output tables clearly show.

Power Supplied to the Furnace.—Although the furnace was designed for a much larger capacity, the power available at the time was only 400 to 450 kw. The tension was kept at between 40 and 50 volts, and the power factor—which, with the lower tension during the first part of the run was 0.85—rose to 0.90 with the higher tension.

A point in the construction of the furnace deserving of special attention is the almost complete absence of fluctuation in the instruments for recording the current and tension delivered. This, in former electric furnaces, occasioned a serious difficulty, and necessitated either the installation of automatic electrode regulators, or the constant presence of a man at the switchboard for adjustment and regulation. In this case, however, the only regulation required is that corresponding to the consumption of the electrodes, which requires to be done once a day, and sometimes for slightly longer periods. The cost of the electric installation for this furnace, compared with that of other types, is therefore cheaper, inasmuch as the costly apparatus for controlling the electrodes is dispensed with. Since the fluctuation of power is almost negligible, and current shocks do not have to be taken into consideration, this type of electric furnace constitutes an ideal load for a power station.

### The Trial Run.

The trial run was started at 6.30 a.m., December 27, when the readings of the different measuring instruments were taken and recorded every half hour. Samples of the pig iron and slag were taken for analysis, and the iron—after the slag had been entirely removed—carefully weighed. During the first part of the trial the composition of the charge was: Ore, 209.0 lbs.; coke, 48.4 lbs.; lime 11.0 lbs. The coke used in this charge corresponds to a consumption of about 810 lbs. per ton (2,240 lbs.) of pig iron. During tapping, however, carbon was observed to escape through the tap-hole with the slag, which, in addition, contained a considerable amount of carbide. This indicated an excess of carbon. The charge was, therefore, altered the next morning to the following composition: Ore, 209.0 lbs.; coke, 42.0 lbs.; lime, 4.4 lbs.; corresponding to a consumption of carbon of about 704 lbs. per ton of pig iron. On the evening of the same day the charge was again changed to: Ore, 220.0 lbs.; coke, 41.8 lbs.; lime, 4.4 lbs.; which corresponds to a consumption of carbon of about 671 lbs. per ton of pig iron.

The coke used up to this time was very wet, having been exposed to rain and snow. As, however, dry coke, which consequently contained a higher percentage of carbon per unit weight, was now available, the charge was again changed to: Ore, 220.0 lbs.; coke, 37.4 lbs.; lime, 4.4 lbs.; which corresponds to a consumption of coke of about 605 lbs. per ton of pig iron. This might be further reduced when the furnace is working normally, and the gases circulated as previously described. However, this consumption of carbon must be considered as extremely satisfactory.

Analyses of the pig iron from six different tappings, and of the slag from tapping No. 4, are given below. From an inspection of these analyses it will be seen that the sulphur content, especially in the last one, is exceedingly low. During the last tapping the temperature of the furnace was higher than in the former tappings, which accounts for the low sulphur content.

### Analyses of Pig Iron Produced.

| Cast. No. | C | Si | Mn | P | S |
|---|---|---|---|---|---|
| 2 | 3.20 | 0.056 | 0.32 | 1.80 | 0.015 |
| 3 | 3.20 | 0.103 | 0.37 | 1.50 | *— |
| 4 | 3.40 | 0.065 | 0.34 | 1.64 | 0.015 |
| 5 | 3.20 | 0.075 | 0.32 | 1.80 | *— |
| 9 | 3.20 | 0.075 | 0.39 | 1.90 | 0.015 |
| 13 | 3.15 | 0.070 | 0.24 | 2.06 | 0.005 |

* Undetermined.

The analysis of slag from cast No. 4 was as follows: $SiO_2$, 26.54 per cent.; CaO, 54.48 per cent.; S, 0.78 per cent.; Fe 0.35 per cent.

The readings of the volts and amperes, and the consumption of energy, are given in the following table. As previously explained, these figures cannot serve as a criterion for judging the process commercially, and are only inserted here as they may be of some interest from a technical point of view:—

**Electrical Measurements.**

| Date | Time | Amperes. I. | II. | III. | Volts. | Kw. | Remarks. |
|---|---|---|---|---|---|---|---|
| Dec. 27 | 6.30 a.m. | 6,800 | 6,800 | 6,800 | 41 | 400 | |
| " | 7.00 " | 6,800 | 6,800 | 7,000 | 42 | 415 | |
| " | 7.30 " | 7,000 | 7,000 | 7,000 | 40 | 400 | |
| " | 8.00 " | 7,000 | 7,000 | 7,000 | 41 | 405 | |
| " | 8.30 " | 6,800 | 7,000 | 6,800 | 42 | 415 | |
| " | 9.00 " | 7,000 | 7,000 | 7,000 | 40 | 400 | |
| " | 9.30 " | 6,800 | 7,000 | 7,000 | 40 | 395 | 2,860 lbs. of |
| " | 10.00 " | 6,800 | 6,800 | 6,800 | 40 | 385 | pig iron cast. |
| " | 10.30 " | 7,000 | 7,000 | 7,000 | 40 | 400 | |
| " | 11.00 " | 7,200 | 7,000 | 7,600 | 38 | 380 | |
| " | 11.30 " | 7,200 | 7,000 | 7,200 | 38 | 375 | |
| " | 12.00 " | 7,200 | 7,200 | 7,400 | 33 | 325 | |
| " | 12.30 p.m. | 7,200 | 7,200 | 7,400 | 39 | 390 | |
| " | 1.00 " | 7,200 | 7,200 | 7,400 | 38 | 380 | |
| " | 1.30 " | 7,200 | 7,600 | 7,200 | 36 | 360 | |
| " | 2.00 " | 7,400 | 7,400 | 7,200 | 36 | 360 | 1,067 lbs. of |
| " | 2.30 " | 7,400 | 7,200 | 7,400 | 38 | 385 | pig iron cast. |
| " | 3.00 " | 7,200 | 7,200 | 7,200 | 40 | 400 | |
| " | 3.30 " | 7,400 | 7,200 | 7,400 | 39 | 395 | |
| " | 4.00 " | 7,400 | 7,400 | 7,600 | 40 | 415 | |
| " | 4.30 " | 7,200 | 7,200 | 7,400 | 38 | 380 | |
| " | 5.00 " | 7,200 | 7,200 | 7,400 | 40 | 405 | |
| " | 5.30 " | ..... | ..... | ..... | .. | ... | Power off, due |
| " | 6.00 " | ..... | ..... | ..... | .. | ... | to change on |
| " | 6.30 " | ..... | ..... | ..... | .. | ... | switchboard |
| " | 7.00 " | 6,200 | 6,400 | 6,600 | 42 | 380 | wiring. |
| " | 7.30 " | 6,600 | 6,800 | 7,000 | 40 | 380 | |
| " | 8.00 " | 6,800 | 7,000 | 7,000 | 40 | 385 | |
| " | 8.30 " | 7,200 | 7,200 | 7,000 | 36 | 350 | 1,411 lbs. of |
| " | 9.00 " | 7,200 | 7,200 | 7,000 | 36 | 350 | pig iron cast. |
| " | 9.30 " | 7,400 | 7,400 | 7,400 | 36 | 365 | |
| " | 10.00 " | 7,400 | 7,400 | 7,400 | 36 | 365 | |
| " | 10.30 " | 7,400 | 7,400 | 7,200 | 37 | 370 | |
| " | 11.00 " | 7,200 | 7,400 | 7,200 | 36 | 355 | |
| " | 11.30 " | 7,200 | 7,400 | 7,000 | 36 | 350 | |
| " | 12.00 " | 7,200 | 7,400 | 7,000 | 36 | 350 | |
| Dec. 28 | 12.30 a.m. | 7,000 | 7,400 | 6,800 | 40 | 395 | |
| " | 1.00 " | 7,000 | 7,400 | 7,000 | 40 | 400 | |
| " | 1.30 " | 7,000 | 7,400 | 7,000 | 40 | 400 | |
| " | 2.00 " | 7,000 | 7,400 | 6,800 | 40 | 395 | 1,650 lbs. of |
| " | 2.30 " | 7,000 | 7,400 | 7,000 | 40 | 400 | pig iron cast. |
| " | 3.00 " | 7,000 | 7,200 | 7,000 | 38 | 375 | |
| " | 3.30 " | 6,800 | 7,400 | 7,000 | 39 | 385 | |
| " | 4.00 " | 6,800 | 7,200 | 6,800 | 39 | 375 | |
| " | 4.30 " | 7,000 | 7,400 | 7,200 | 36 | 355 | |
| " | 5.00 " | 7,200 | 7,400 | 7,200 | 36 | 355 | |
| " | 5.30 " | 7,400 | 7,400 | 7,600 | 37 | 380 | |
| " | 6.00 " | 7,200 | 7,200 | 7,400 | 36 | 360 | |
| " | 6.30 " | 7,200 | 7,400 | 7,400 | 38 | 385 | |
| " | 7.00 " | 7,200 | 7,400 | 7,400 | 38 | 385 | |
| " | 7.30 " | 7,400 | 7,600 | 7,600 | 36 | 370 | |
| " | 8.00 " | 7,400 | 7,400 | 7,600 | 36 | 365 | 1,870 lbs. of |
| " | 8.30 " | 7,400 | 7,400 | 7,400 | 38 | 385 | pig iron cast. |
| " | 9.00 " | 7,200 | 7,200 | 7,400 | 38 | 380 | |
| Dec. 28 | 9.00 a.m. | 7,200 | 7,200 | 7,400 | 38 | 380 | |
| " | 9.30 " | 7,400 | 7,400 | 7,400 | 36 | 365 | |
| " | 10.00 " | 7,200 | 7,200 | 7,200 | 38 | 375 | |
| " | 10.30 " | 7,200 | 7,400 | 7,400 | 38 | 385 | |
| " | 11.00 " | 7,400 | 7,400 | 7,400 | 36 | 365 | |
| " | 11.30 " | 7,400 | 7,400 | 7,600 | 38 | 390 | |
| " | 12.00 " | 7,400 | 7,600 | 7,800 | 38 | 400 | |
| " | 12.30 p.m. | 7,600 | 7,800 | 7,600 | 40 | 430 | |
| " | 1.00 " | 7,600 | 7,600 | 7,800 | 38 | 406 | |
| " | 1.30 " | 7,600 | 7,400 | 7,600 | 38 | 395 | |
| " | 2.00 " | 7,600 | 7,400 | 7,600 | 38 | 395 | |
| " | 2.30 " | 7,600 | 7,600 | 7,400 | 40 | 425 | |
| " | 3.00 " | 7,200 | 7,400 | 7,600 | 36 | 365 | |
| " | 3.30 " | 7,200 | 7,600 | 7,400 | 38 | 385 | |
| " | 4.00 " | 7,200 | 7,200 | 7,400 | 45 | 406 | |
| " | 4.30 " | 7,400 | 7,400 | 7,800 | 38 | 395 | |
| " | 5.00 " | 7,400 | 7,400 | 7,800 | 40 | 425 | |
| " | 5.30 " | 7,400 | 7,400 | 7,600 | 40 | 415 | 1,430 lbs. of |
| " | 6.00 " | 7,400 | 7,400 | 7,600 | 42 | 440 | pig iron cast. |
| " | 6.30 " | 7,200 | 7,200 | 7,600 | 40 | 410 | |
| " | 7.00 " | 7,200 | 7,200 | 7,400 | 40 | 405 | |
| " | 7.30 " | 7,200 | 7,400 | 7,400 | 40 | 410 | |
| " | 8.00 " | 7,200 | 7,400 | 7,200 | 38 | 380 | |
| " | 8.30 " | 7,400 | 7,400 | 7,600 | 38 | 390 | |
| " | 9.00 " | 7,200 | 7,200 | 7,600 | 38 | 385 | |
| " | 9.30 " | 7,000 | 7,400 | 7,400 | 38 | 380 | |
| " | 10.00 " | 7,200 | 7,200 | 7,600 | 37 | 370 | |
| " | 10.30 " | 7,400 | 7,400 | 7,400 | 38 | 380 | |
| " | 11.00 " | 7,200 | 7,600 | 7,600 | 38 | 390 | 2,343 lbs. of |
| " | 11.30 " | 7,200 | 7,600 | 7,400 | 38 | 385 | pig iron cast. |
| " | 12.00 " | 7,400 | 7,200 | 7,400 | 39 | 395 | |
| Dec. 29 | 12.30 a.m. | 7,400 | 7,200 | 7,600 | 39 | 400 | |
| " | 1.00 " | 7,600 | 7,400 | 7,800 | 39 | 410 | |
| " | 1.30 " | 7,400 | 7,400 | 7,600 | 39 | 405 | |
| " | 2.00 " | 7,400 | 7,400 | 7,600 | 38 | 390 | |
| " | 2.30 " | 7,600 | 7,400 | 7,600 | 38 | 395 | |
| " | 3.00 " | 7,400 | 7,400 | 7,600 | 38 | 390 | |
| " | 3.30 " | 7,600 | 7,200 | 7,600 | 37 | 380 | |
| " | 4.00 " | 7,800 | 7,800 | 8,000 | 37 | 400 | |
| " | 4.30 " | 7,800 | 7,600 | 7,800 | 36 | 380 | |
| " | 5.00 " | 7,800 | 7,600 | 7,800 | 36 | 380 | 1,562 lbs. of |
| " | 5.30 " | 7,800 | 7,400 | 7,800 | 36 | 375 | pig iron cast. |
| " | 6.00 " | 7,800 | 7,400 | 7,800 | 35 | 365 | |

It may be pointed out that the output continued to steadily rise as the furnace more nearly approached its normal working condition—even with the inadequate power supplied—until an unfortunate accident occurred to one of the water cooled stuffing boxes, necessitating the removal of one electrode.

Towards the end of the run, one of the cast-iron water-cooled stuffing boxes developed a bad crack, which allowed large quantities of water to escape into the furnace. This would not have occurred had sufficient time been allowed for the thorough testing of all the castings, and cannot happen in the future, since the design of these water-cooled stuffing boxes has been changed. But even while running with only two electrodes, the output again began to rise when the heat lost by the water escapting into the furnace was partially restored to the walls of the furnace, and to the wet charge in the shaft.

The time limit set by the director of the company for the delivery of power to the furnace, was January 1, 1909; it was necessary, therefore, that the latest charge in the furnace should be all melted down, and tapped out, prior to that date. This was accordingly anticipated, and the official trial run was discontinued at 6 a.m., December 29, 1908.

In the following table is given the number of tons of pig iron produced per electrical horse-power-year, in casts Nos. 2 to 10, inclusive:—

| Cast No. | Tons of pig iron per E.H.P. year |
|---|---|
| 2 | 0.744 |
| 3 | 1.870 |
| 4 | 2.180 |
| 5 | 2.360 |
| 6 | 2.440 |
| 7 | 1.120* |
| 8 | 3.160 |
| 9 | 1.950 |
| 10 | 1.030 |

From the foregoing table it will be seen that the output before the leakage of water into the furnace became serious was 2.44 metric tons per electrical horse-power-year. This figure—considering the disadvantagest under which the trial was made—may be deemed very satisfactory. Owing to the short duration of the trial, it was impossible to determine the consumption of electrodes per ton of pig iron produced. According to former tests, however, this may be placed at about 11 lbs. per metric ton (2,204 lbs.) of pig iron produced.

The trial run was intended to elucidate the following

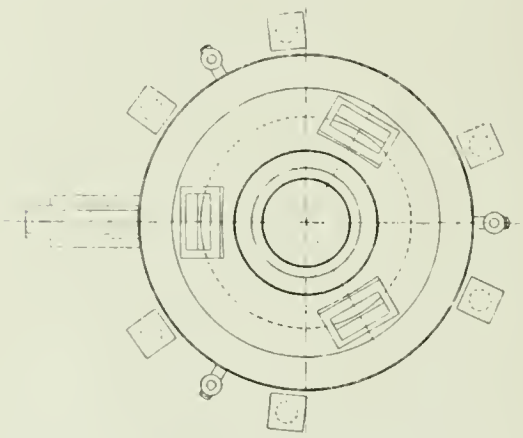

**Fig. 6.—Plan of Furnace with Shaft and Electrodes Removed.**

points: (1) Whether undisturbed and uniform working without troublesome regulation of the electrodes could be obtained. (2) Whether great variations in the consumption of energy would occur. (3) Whether the free spaces within the melting chamber would be maintained with a shaft considerably higher than in the furnaces of earlier design and construction. (4) Whether the contraction of the shaft would prevent the charge from sinking uniformly, or cause hanging. (5) The durability of the arched roof, and the possibility of cooling it by means of the circulating gas.

### Deductions from Observations.

The following is a summarized statement of practical deductions drawn from observations made during the trial run, having regard to the objective points specified above:—

(a) It was observed that the furnace operated uniformly and without trouble of any kind, and that the electrodes required absolutely no regulation, in one case, for five consecutive days. In any case, the only regulation required is that corresponding to the consumption of the electrodes, and is necessary only once a day, and sometimes not for much longer periods. On account of this expensive regulation can be dispensed with.

(b) During the short trial, even though the furnace did not approach its normal working condition until towards the end, it was observed that the consumption of energy was remarkably uniform. This can readily be seen from an inspection of the readings of the different instruments.

(c) Free spaces were maintained between the linings of the roof and walls, and the electrodes and charge at the openings where the electrodes enter the melting chamber.

(d) It was found that the charge did not jam in the lower contracted neck of the shaft, as had been feared, but moved with regularity into the melting chamber.

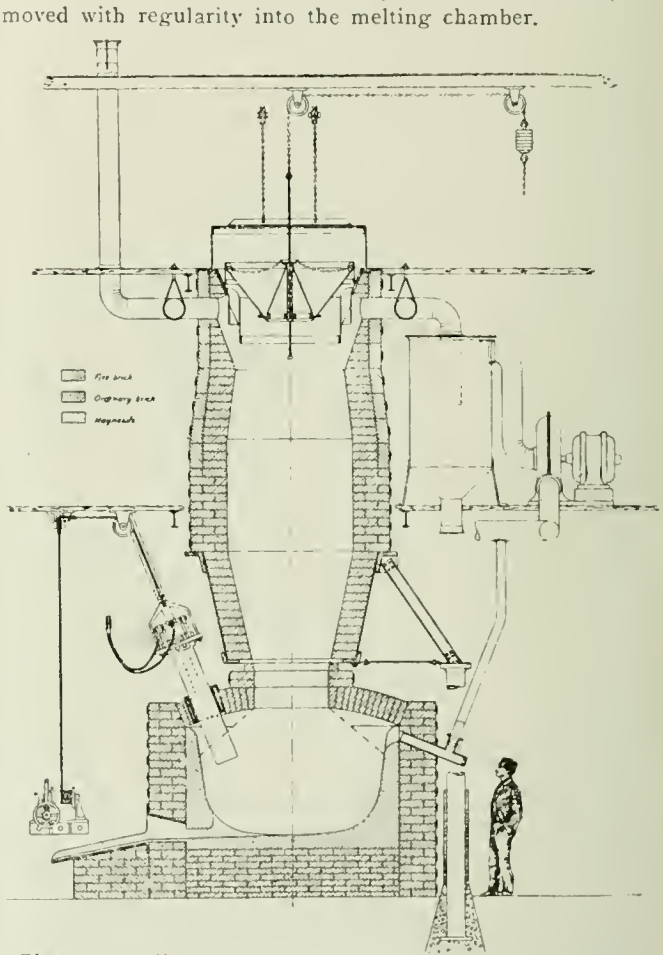

**Fig. 5.—Sectional Elevation of Electric Shaft Furnace.**

(e) Although the gases generated by the reduction of the ore were not circulated through the cooling tuyeres until near the end of the trial run, it was demonstrated that the lining of the roof of the melting chamber was effectively cooled by this means.

### Comparison of the Cost of Production of Pig Iron in the Charcoal Blast Furnace with that Produced in the Electric Shaft Furnace.*

By Professor von Odelstierna (Stockholm).

If we take as a basis for our comparative study an ordinary charcoal blast furnace, and the electric shaft furnace

* Electrode holder began to leak badly.

† Water leaked into the furnace in small quantities from the beginning of the trial, but was not so noticeable until after the seventh cast.

* Based upon conditions in Sweden.

erected at Domnarfvet, and suppose the iron ore used in these furnaces to contain 60 per cent. metallic iron, and the charcoal 83 per cent. carbon, then it should be possible to make a reliable comparison. It should be pointed out, however, that in this comparison no account is taken of the fact that the gases produced in the electric shaft furnace contain a higher percentage of CO—probably 60 per cent. more—than the ordinary blast furnace gases.

In regard to the labor charges and general expenses, I make the supposition that these charges are the same for both the electric shaft furnace and the charcoal blast furnace, if the contrasted furnaces are of such capacity as to produce the same quantity of pig iron per year. A charcoal blast furnace of medium capacity produces in Sweden about 8,000 to 10,000 short tons (2,000 lbs.) of pig iron per annum—a quantity which, I believe, can also be produced in a properly constructed electric shaft furnace of the type of that of the Aktiebolaget Electrometall.

**Cost of Pig Iron per Short Ton (2,000 lbs.).**

Charcoal Blast Furnace.

| | s. | d. |
|---|---|---|
| Charcoal 0.95 ton at 32s. per ton | 30 | 6 |
| Labor | 4 | 0 |
| Repairs and general expenses | 6 | 0 |
| | 40 | 6 |

Electric Shaft Furnace.

| | s. | d. |
|---|---|---|
| Charcoal 0.27 ton | 8 | 8 |
| Electrical energy, 0.3 E.H.P.-year at 48s. | 14 | 4 |
| Labor | 4 | 0 |
| Electrodes, 10 lbs. at 1½d. per lb. | 1 | 3 |
| Repairs and general expenses | 6 | 0 |
| | 34 | 3 |

In this calculation the price of ore and limestone and the royalty are not given, as the former varies with the locality and the character of the ore, and the latter has not yet been determined. From this calculation it is apparent that in Sweden, under the above mentioned circumstances, a saving of 6s. 3d. should be effected in the production of pig iron by the electro-thermic process.

## CONCRETE FAILURES.*

**By Frank M. Okey, Engineering Experiment Station, Iowa State College.**

In presenting a discussion of this subject to the Association of Iowa Cement Users, it is not the purpose of the writer to make any hostile attack upon concrete, nor to enter into any controversy in regard to its merits or demerits. In fact, it is not my purpose to make any attack at all, but rather to present a discussion of those causes which result in failure, in the hope that workers with this most modern of building materials may profit therefrom by seeking to eliminate such causes as are apt to result more or less disastrously.

The two words "concrete" and "failures" when used in the connection in which they appear in my subject have more or less of a funeral sound, and I doubt not that more than one cement user is harboring hostile thoughts of which the writer is the subject. But let me ask you to be lenient and reserve your judgment till I have done. Then I hope to have dispelled any attitude of hostility on your part, and to appear not in any sense an enemy of concrete, but a warm friend who has concrete interests deeply at heart.

The concrete industry is to-day occupying a very large place in the minds of the American public, and well it may, for none other of the materials of construction has made such giant strides in demonstrating its suitability and adaptability as a building material. One has to make but little search to prove that the fields in which concrete is demonstrating its advantages are indeed wide and varied. The discovery of uses to which this much used and much abused material may be adapted seems to continue without end, and perhaps therein lies a menace. The industry is confronted with a situation both gratifying and alarming. The products are growing in favor, but there is great danger, only temporary, I am sure, but none the less real, from the friends and advocates, some of whom in their zeal, inexperience and unlimited confidence, attempt the impossible, or perhaps are quite impossible in the attempt, however legitimate.

The over-zealous advocate, in seeking new worlds to conquer, imagines that a certain thing would be much better if made of concrete, and straightway, without further investigation or proper preparation, proceeds to demonstrate. Not infrequently the result is disastrous failure, and the zealot calls down condemnation not upon himself, but upon a good thing, which if rightly managed could have been only commended. It is against such foolish ventures as this that the concrete worker should guard. He must be conservative and use good sense and good judgment; make or have made the proper plans and designs, investigate thoroughly the use to which the material is to be put, select good ingredients, carefully inspect construction and the result will be concrete that will not only add to its already great host of friends, but will prove to its enemies that their calamity howling is very ill advised.

In the words of a prominent engineer, "The great problem confronting us now is to properly and adequately meet, foster and encourage the wide spreading interest in this industry and yet not permit it to grow beyond a safe control. By this, I mean that every effort should be made to avoid and prevent the mistakes and failures and disappointments that surely attend undue haste and want of preparation in the way of proper design, intelligent supervision and employment of trained and experienced men. All this has been found necessary to avoid failure in the use of other materials of construction, then why not in the use of the plastic materials."

Coming specifically to those causes whose result is failure, there are two sources to be investigated, the materials themselves, and the workers; the latter including not only those who actually mix the concrete and deposit it in place, but the foreman, the contractor, the inspector, and the engineer and designer.

It goes without question that to obtain good concrete, good Portland cement must be used. I heard a contractor make the statement not long ago that the manufacturers of cement were reaching so high a standard nowadays, and their product was running so uniform, that it was almost a waste of time to have a shipment sampled and tested. I am sure that the manufacturers will appreciate this compliment, but nevertheless we must not think for an instant that vigilant inspection should be relaxed, nor that we should fail to

* Read before the Iowa Cement Users Association.

have even a single car of any shipment tested. There is always chance of a slip, and that slip may prove highly expensive. Facilities for cement testing are available nearly everywhere, and the cost of the tests is not a penny compared to the damage resulting from a single car of bad cement. However, it is seldom that a sample fails to pass the requirements. The specifications of the American Society of Civil Engineers are made lenient enough that a cement failing to pass them ought to be rejected. Many cements pass above even the highest limit required in tensile strength. This statement is based on the results of about forty tests made on twelve or fourteen different brands of Portland cement during the past year. More than sixty per cent passed the higher limit for tensile strength and only three samples failed to pass at all.

So I am firm in my stand that all cement used should be subjected to all the tests required by the American Society specifications, and it is up to the contractor to have the cement on hand long enough for complete tests to be made, which means not less than thirty days.

Mr. W. A. Aiken, V. P. of the Spackman Eng. Company of Philadelphia makes the following statements in the Concrete Age for January 1909, relative to cement inspection: "The place to inspect cement, and incidentally to test it, is at the point of manufacture, and not after the material has been delivered on the work, where even if condemned on test, and tests alone without intimate acquaintance with the product means less than generally thought, it is a difficult and expensive operation to prevent its possible use, either through the instance of the manufacturer's agent or the demands of construction. .... The necessity for inspection in no way reflects on the manufacturer, since intelligent inspection is valuable to both producer and consumer, and must of necessity result in raising the quality of the product, no matter what the material. While the percentage of cement rejected through inspection is not large, as a rule, taking the whole volume of the industry into account, every one engaged in using this material should realize the value of inspection and appreciate that the discovery of and prevention in the use of even a small per cent. gives the purchaser an assurance of quality that can be accomplished in no other way."

But to make concrete an aggregate is necessary; sand and a coarser material, usually gravel or broken stone, and occasionally, when a concrete of lighter weight is desired, cinders.

The important part sand plays in concrete work is not generally recognized, and even among contractors and engineers who have at some time experienced trouble directly traceable to the sand used, there is found the tendency to depend too much at times on a superficial examination. It is certainly marvellous to observe what wonderful binding qualities cement has when it is mixed in the proportion of one to three of sand and five or six of stone. But we must note, however, that the cement must be spread out pretty thin to fill the interstices of the sand and coat the surface of the individual grains three times in volume the cement used. If the sand, however, be poor by reason of its geological origin, mineral composition or decomposition, or because of excessive fineness or its content of fine material of a non-siliceous nature, then it is useless to expect good results of such proportions as three of sand to one of cement. Only careful analysis and tests of the sand will enable us to judge as to whether it should be used at all, and, if so, in what proportions to attain the desired results within the required working limits of seven or twenty-eight days.

Sand should be clean and coarse, and the individual grains should be firm. If the grains are covered with a thin film of dirt or clay, the cement can not get a bond and when concrete made with such sand is broken, the fracture shows that the grains pull out of the cement and leave little pits lined with a film of clay. Undoubtedly, such concrete is weak. I know I am treading on dangerous ground when I say that clay in sand is a detriment for many tests have shown that sand that contained a considerable percentage of clay and loam developed a higher strength than sand that was clean. But I believe as a usual thing clean sand is the safer. In a piece of recent concrete construction, it was found when removing the forms from a column that between the batches of concrete there was a thin layer of what proved to be clay. The sand used contained quite a percentage of this substance, and in tamping the concrete, which was quite wet, the clay had come to the top and formed a layer of appreciable thickness. The column was of course torn out and rebuilt. Further, if the grains are weak individually, and easily fractured, such a sand should be discarded as dangerous.

Coarse sands give a stronger concrete than fine. Tests made by Peret, a Frenchman, showed that in mixtures of one cement to two and one-half sand the coarse sand developed a strength of 421 pounds per square inch in five months, medium sand 168 pounds, and fine 300 pounds. The variation in crushing strength was more marked, showing 5,200 pounds per square inch for coarse, 3,400 pounds for medium and 1,900 pounds for fine.

The best sand is that which is so graded that the voids are at a minimum, or according to M. Peret, where the proportions of coarse grains to fine is two to one. One of our eminent authorities on concrete, Mr. Sanford E. Thompson, states that sharpness is not an essential characteristic of sand. He says: "The majority of specifications still call for 'sharp' sand, and yet I have never known a sand to be rejected because of its lack of sharpness. As a matter of fact, if two sands have the same sized grains, and contain an equal amount of dust, the one with rounded grains is apt to give a denser and stronger mortar than the sharp grained sand. A sand with 'sharp' feel is preferable to another, not to any extent because of its sharpness, but because the grittiness indicates a siliceous sand which is apt to have no excess of fine material."

Much care should be taken in the use of gravel. In some of the gravel used for concrete, many of the pebbles are of very soft composition and easily broken, and some in fact can be crumbled between the fingers, while not a few which seem quite hard are only a shell surrounding a very soft interior. Concrete made with gravel of this kind is weaker than it appears, for every poor pebble reduces the area of the member by an area equal to its own cross-section. That the individual pebbles should be clean goes without saying, for cement can not gain a good hold on a surface that has a coat of clay or loam, however thin, and when the strain comes, the pebbles pull out, leaving pockets lined with a film of the dirt.

The hardness of the stone used, the shape of the particles, their maximum and relative size, materially effect the resulting concrete. I refer now to broken stone. When there is opportunity for choice, the best is that which is hard, with cubical fracture, and with particles whose size is as large as can be handled in the work. Crushed limestone is most used, as the coarser aggregate in this part of the country, and Thompson rates it fifth in his scale of values of aggregates, which is as follows: Trap rock, granite,

gravel, marble, limestone, slag, sandstone, slate, shale, and cinders. Mr. Thompson gives this classification as the result of a large number of tests, which showed that the hardest stone produced the hardest concrete. He says further that the hardness of the stone grows in importance with the age of the concrete. Thus gravel concrete, because of the rounded surfaces, at the age of one month may be weaker than a concrete made with comparatively soft broken stone, but at the age of one year it may surpass in strength the broken stone concrete because, as the cement becomes hard, there is a greater tendency for the stones themselves to shear through, and the hardness of the gravel stones thus comes into play. This would certainly be equally true of the harder broken stones. It is best to avoid the use of a stone that breaks into flat pieces, for such material packs less closely and is generally inferior to stone of cubical fracture.

Of cinders, I have little to say, other than that they should be free from partially burned coal and fine ashes. Thompson rates them as the poorest material for an aggregate, and I believe their use should be undertaken with much caution.

However, while many failures of concrete structures are directly traceable to faults in the materials used, by far the greater number are due to poor workmanship and poor design. A certain man, who, by the way, is hardly to be classed as a friend of concrete, distorts Punch's famous advice to apply to concrete construction, thus: "Building with concrete, whether reinforced or not, is an undertaking not to be attempted rashly, but prayerfully, and the petition of salvation should never be so intent as when centres are about to be struck."

There is scarcely a field of building operations in which at first glance it seems simpler for the relatively inexperienced to do satisfactory work than in the use of concrete. Here are simple materials—sand, gravel and cement—mixed by crude labor, usually handled in a crude way, and not infrequently the results are equally crude. I have seen and so have you, many a man posing as a concrete contractor who has no more business in that line of work than a brick mason at a jeweller's bench. It is greatly to be regretted that it is a popular idea that a very low grade of labor may be employed in mixing and placing concrete; and it is equally regrettable that this idea is carried out in practice. While it is true that the greater amount of the hard work necessary in concrete construction can be performed by men relatively inexperienced and unlearned in this occupation, the engineer and inspector should insist that the contractor place over them a foreman who thoroughly understands the principles of mixing and placing. Not only must the foreman be capable, but he must be honest, and I am sure you will agree with me that it is materially to the contractor's advantage to have a man of that kind in direct charge of work. I do not wish to be understood to say that the majority of foremen are dishonest, but I have seen men in charge of construction who, the minute the inspector's back was turned, began skimping. A little of the cement was left out or an addition made to the aggregate; reinforcement was carelessly spread or wrongly set; sawdust and chips were left in the forms and dirt was shoveled up with the sand and rock. It is not necessary to further enumerate these things, for many of you are more familiar with them than I, but more than one failure has been directly traced to the skimping of the foreman who did it thinking, not only that he was "slipping one over" on the inspector, but that he was saving money for the contractor who employed him. The sooner the minds of such foremen are disabused of these mistaken ideas, the better it will be, not only for the contractor, but the concrete industry in general.

While, however, the contractor is held directly responsible for failure, it is highly desirable that the engineers who have in charge the execution of the designer's plans, be most efficiently schooled in the business, and know for a certainty what to allow and what not to allow in construction. For the very flexibility and facility for rapid working of concrete invite disaster, if even the most responsible designs and installations be placed in inexperienced hands.

As a final word, let me insist on conservatism. I firmly believe that more detriment is being done to day to the concrete industry by its friends through over zealousness than by all the calumny and ridicule heaped upon it by its opponents. Poor concrete must be relegated to the past, and the maker of poor concrete must be made to come to time or be outlawed and forced to quit.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8137—September 14th—Directing that in the operation of railway lines where the snowfall is such as to require the running of snowplows or flangers, the company may remove the planks from farm crossings; provided that no such planks shall be removed unless necessary, and shall be replaced by the company in the spring, or as soon as the snow is off the ground.

8138—September 21st—Granting leave to the C.N.Q. Railway to permanently open for traffic that portion of its line from its connection with the line of the Quebec and Lake St. John Railway in city of Quebec, to Garneau Junction, a distance of 78.76 miles.

8139—September 15th—Refusing the Toronto Railway Company leave to appeal Order of the Board No. 7,813, dated the 3rd July, 1909, authorizing the city of Toronto to construct a bridge across its tracks where the same crosses Queen Street East, in the said city.

8140—September 14th—Granting leave to the Nipissing Central Railway to construct its railway across the track of the Temiskaming & Northern Ontario aRilway by means of an overhead crossing, in the town site of Argentite, Ont.

8141—September 22nd—Granting leave to the Rural Municipality of Macdonald, to place its wires across the track of the C.N.R. Company at public crossing ¾ mile north-east of Sanford, Manitoba.

8142—September 14—Ordering the G.T.R. to clean present station at Seguin Falls, Ont.; to provide and maintain proper station seats and lamps; and to construct platforms, etc., at above point.

8143—September 22—Directing that the time for the completion of the work in connection with the bridge (No. 1.65 C.P.R.) carrying St. Catharines Street, Montreal, P.Q., over C.P.R. tracks be extended until first day of May, 1910.

8144—September 21—Authorizing the G.T.R. to operate its trains across the track of the Winnipeg Electric Street Railway at Pembina highway, Winnipeg, Man., without being brought to a stop.

8145—September 14—Ordering that all railways subject to the jurisdiction of the Board equip, before the first day of April 1910, its freight vans with coupler-operating levers, and the cupolas of its cabooses with air-gauges and air-controlling valves.

# ENGINEER'S LIBRARY

## A SUBJECT FOR WINTER STUDY.

It is just as true of engineering as of any other profession that advancement comes with study and much reading. So long as the engineer has to do with the detail of design and construction he must continually familiarize himself with theories, failures and successes of others. He must compare his results with what has been accomplished elsewhere.

Miscellaneous reading is good. One must be informed on many questions that have but a little bearing on their regular work.

To become master of a particular subject the study must be regular, well directed and continuous, and for the engineer anxious to widen his range of information and to train himself for new problems we know of no better way than to choose a subject for winter reading, map out a course of reading on that subject and religiously follow it for several months. Not only must he read, but he should prepare notes, and even—when the subject lends itself to this treatment—design and work out in some detail plans.

Sometimes one reads to find out **where** certain information is. That kind of reading is quite necessary, but the mind needs other training, and that must be secured by the more laborious method of close study, repetition, note-making and review.

Several engineers have already chosen their subject for this winter's reading, and will greatly profit by the experience.

## THE CANADIAN ENGINEER'S MONTHLY INDEX OF CIVIL ENGINEERING LITERATURE.

The purpose of this monthly index is: To inform engineers and contractors of the literature published on those subjects in which they are especially interested, the character of the article and the journal in which it appeared. **We do not index in this section articles that appear in The Canadian Engineer.**

Periodicals containing articles indexed, should be ordered direct from the publishers.

### LIST OF PERIODICALS INDEXED.

**Canadian Society of Civil Engineers Proceedings.**—(Can. Soc. C. E. Proc.), Montreal, Can., m., 4 x 7 in., 50 cents.

**Canadian Cement and Concrete Review.**—(Can. Cem. and Con. Rev.), Toronto, Ont., m., 9 x 14, 15 cents.

**Contractor.**—(Contr.), Chicago, Ill., bi.-w.; 7 x 10 in., 20 cents.

**Engineering—Contracting.**—(Eng.-Cont.) Chicago, Ill., w.; 9 x 12 in., 10 cents.

**Engineering News.**—(Eng. News), New York, N.Y., w.; 10 x 14 in., 15 cents.

**Engineering Magazine.**—(Eng. Mag.), New York, N.Y., 7 x 10 in., 25 cents.

**Machinery.**—(Mach.), New York, N.Y., m., 7 x 11 in., 25 cents.

**Municipal Journal and Engineer.**—(Mun. Jl. and Eng.), w., New York, N.Y., 9 x 12, 10 cents.

**Municipal Engineering Magazine.**—(Mun. Eng. Mag.), Indianapolis, Ill., m., 7 x 10 in., 25 cents.

**Power and Engineer.**—(Pow. and Eng.), New York, N.Y., w.; 9 x 12 in, 5 cents.

**Railway Age Gazette.**—(R. R. Age Gaz.), New York, w.; 8 x 11 in., 15 cents.

**Surveyor, The.**—(Sur.), London, Eng., w.; 6 x 11, 10 cents.

**Engineering.**—(Engr.), London, Eng., w.; 12 x 15 in., 15 cents.

* Illustrated.

## SEWERS, SEWAGE AND WATERWORKS.

**Concrete Sewer Construction at Waukegan, Ill.***—1 p., contr., October 1, 1909.

**Sewer Construction at Jackson, Mich.***—A reinforced lock-joint concrete pipe system, Mun. Jl. and Engr., Sept. 29, 1909., 3 pp.

**The Sterilization of the New Jersey Water Supply.**—Sur. Sept. 24, 1909, 1 p.

## RAILWAYS.

**The Makatote Viaduct,* on the North Island Main Trunk Railway** in New Zealand. Length, 895 feet. Piers, 270 feet high. Engr., Sept. 3, 1909, 4 pp.

**Increasing the Efficiency of the Electric Motor Drive.**—A digest of a series of electric driving tests and methods for determining the fitness of any given installation. Engr. Mag., Oct.

## MISCELLANEOUS.

**Hammer Drills Applied to Rock Excavation in Sewer Construction.***—Eng. News, Sept. 9, 1909.

**Comparative Cost and Stone Consumption in Diamond Drilling, Using Carbon and Borts.**—Eng. Cont., Sep. 8, 1909.

**Methods of Measuring the Flow of Water.***—Tank Measurements, etc., and Calibration of Flow through a valve. Pow. and Eng., Sep. 7, 1909.

**Principle of Planimeter Operation.***—Explaining simplicity of construction, etc. Pow. and Eng., Sep. 7, 1909.

**Steam Turbines in English Power Houses.***—Some reasons for the popularity of the steam turbine in electrical work. Pow. and Eng., Sep. 7, 1909.

The 180 feet Stone Arch Bridge at Wiesen, Switzerland.* Eng. News, Sept. 16, 1909, 3 pp.

## CONCRETE AND REINFORCED CONCRETE.

**Pressure of Concrete on Forms.***—Eng. News, Sep. 9, 1909.

**The Economics of the Design and Construction of the Walnut Lane Concrete Arch.***—Eng. Cont., Sep. 8, 1909.

**Tests of Plain and Reinforced Concrete Columns.***—Eng. News, Oct. 16, 1909., 3 pp.

**Density and Draining Capacity of Artificial and Natural Mixtures of Sand and Gravel.***—Engr. News, Sep. 23, 1909, 1 pp.

**Moments in Continuous Reinforced Concrete Beams Under Uniform Loading.***—Eng. News, Sept. 30, 1909, 2 pp

**The Design and Construction of Forms for Concrete Work.***—Eng. Cont., Sept. 22, 1909, 1 p.

## ROADS AND PAVEMENTS.

**Dust Abatement by Surface Applications.**—Mun. Eng., Oct., 4 pp.

**Cost of Road Construction in Missouri,** Contr., Oct. 1, 1909.

**The Bridges of New York City,* II.**—Brooklyn Bridge and Brooklyn bridges. Eng. Mag., Oct.

## BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

**Canadian Annual Review of Public Affairs,** 1908; by J. Castell Hopkins, F.S.S. 660 pages, 6 × 9, cloth. Price, $3.50. Published by the Annual Review Publishing Company, Ltd., 2 College Street, Toronto.

Ample proof of Canada's growing importance—the endless march of progress—is offered by the eighth issue of the Canadian Annual Review of Public Affairs, a publication whose scope becomes wider and wider with each succeeding year and the remarkable expansion that is being witnessed on every hand. The Canadian Annual Review is a wonderful volume, and the gentleman mainly responsible for its preparation—Mr. J. Castell Hopkins—is to be congratulated upon the completion of a work which leaves little to be desired. It teems with information in which every man of affairs is vitally interested, and its admirable arrangement, in sixteen parts, containing nearly seven hundred pages, comprises a task to which few are equal. All the important affairs of the Dominion, and of each province, are chronicled and dealt with at length, in a masterful style—a style which all will appreciate.

Transportation is playing an important role in our work of development; and this phase has not been lost sight of. Part IX. is devoted exclusively to transportation interests. In it is found able comment upon the problems and conditions with which the builders of our great highways of commerce have been brought face to face, while the progress of the steam railroads has been summed up in a manner worthy of special mention. Other questions of paramount importance—finance, insurance, empire relations, municipal affairs, literature, journalism, art—are dealt with quite as capably. Beautifully colored photographs of thirty or forty men in the public eye—nation builders—are also included; and it is safe to say that the Canadian Annual Review constitutes the most complete and useful history of the affairs of a country which is great and yet only at the beginning of things.—W. M.

**Dictionary of Chemical and Metallurgical Material,** 1909; 180 pp., 5 × 8; price 50 cents. Published by Electrochemical and Metallurgical Industry, 239 West 39th St., New York, U.S.A.

With commendable enterprise and much care, the publishers of Electrochemical and Metallurgical Industry have compiled a dictionary of chemical and metallurgical material whose value and usefulness can be fully appreciated by only those directly interested. The publication, which represents a timely innovation, is divided into three parts, as follows:—

Part I: Machinery, appliances, and material for chemical and metallurgical industries.

Part II.: Measuring instruments and laboratory supplies.

Part III.: Professional Directory.

The object of the volume is to give purchasers a list of manufacturers of the apparatus they are looking for.

**Building Foreman's Pocket Book and Ready Reference.** By H. G. Richey. Published by Renouf Publishing Company, Montreal, and John Wiley & Company, New York. Pages, 1,110. Price, $5.

This is the first edition of a handbook by H. G. Richey, Superintendent of Construction, United States Public Buildings.

As the title of the book implies, it is intended to be a ready reference for building foremen, or those in charge of the various trades in building operations.

As a building foreman must have a knowledge of all the various trades employed on work in his charge, the author has brought together into one volume such information and knowledge of the different trades as is necessary for a foreman to know or have convenient for reference.

In addition to this matter pertaining to the different trades a large amount of information especially for the use of foremen is given, such as the care of plans, laying out and running work, organization of the working force, etc., which is especially useful and should be of value to any one in charge of work.

A large amount of matter has been given in tabular form so as to be of easy and quick access.

The work is divided into fourteen parts: Duties of foremen; excavating and stone work; brick and terra-cotta work; lime and cements; mortar and concrete; carpentery and wood-work; heating and plumbing; piles and foundations; drawing and laying out work; strength of materials; weight, sizes, etc., of materials; mensuration, and receipts.

**Concrete in Highway Construction.** A Text-book for Highway Engineers and Supervisors. Prepared and published by the Atlas Portland Cement Company, 30 Broad Street, New York City. For gratuitous distribution among engineers, architects, contractors, and road officials; to others, $1.

This work is an octave volume of 136 pages, well illustrated, and containing many working drawings and some valuable tables. As indicated by the title the book deals with the use of concrete in the construction of roads and of structures appurtenant thereto. The subject matter is divided into nine chapters which treat of the following matters: Concrete; sidewalks, surbs and gutters; street pavements; sewers, drain tiles, brook linings and conduits; culverts; beam bridges; arch bridges; retaining walls, and miscellaneous structures.

The illustrations show actual applications of the principles treated in the text, and cover a wide range of engineering practice. The matter of bridge and culvert construction has received especially thorough treatment, the examples shown being well known specimens of typical forms of construction.

**Artificial Waterways and Commercial Development.** By A. Barton Hepburn. Published by the Macmillan Company of Canada, Toronto. 111 pages. Price, $1 net.

As its name implies, this little volume is not an engineering treatise, and its aim, as explained in the author's preface is "to place before the public in concise form the salient facts as to artificial waterways and their relation to commercial development."

The author takes the Erie Canal as a typical case upon which to base his arguments, and the main body of the book is devoted to the political and financial history of this scheme from the time of its inception in 1724 up to the

present time. This portion of the book is of general interest in that it shows the enormous benefit derived from this waterway, during the period of its greatest efficiency, by the port of New York, and the very serious shrinkage in its commerce coincident with the non-development of the canal to keep pace with railway transportation. Statistics are quoted to prove that the State of New York was forced to proceed with the present enlargement of the Erie Canal, at an estimated cost of $101,000,000, to maintain the commercial supremacy of its capital port.

The first chapter of the book is devoted to a general description of the world's artificial waterways, and it is interesting to note that Canada is credited with a greater expenditure per capita for canalization, over a shorter period of time, than any other country in the world.

Another section is devoted to a historical and critical review of the Panama Canal scheme, and the whole concludes with tabulated statistics covering canal operation, costs, dimensions, etc. One table gives the general dimensions and length of the Canadian canals and another shows the progress of work and expenditure on the Panama Canal to July 1908. The time is not far distant when the Canadian ratepayer will be called upon to cast a vote for or against the construction of the Georgian Bay, or the enlargement of the Welland Canal, and to such as desire to vote intelligently, this volume is full of interest.—H. G. A.

**Concrete and Constructional Engineering.**—The current issue of "Concrete and Constructional Engineering" marks an important development, not only of that journal, but of the subject it deals with.

Appearing for more than three years as the pioneer journal devoted to concrete and reinforced concrete as a bimonthly, it has now been decided that the publication shall appear as a **monthly,** and this departure, in the main, is due to the extraordinary development of the subjects of concrete and reinforced concrete, and the uses of Portland cement generally.

The character of the journal remains as heretofore, and it contains as in previous issues, a number of special articles well illustrated, as also a summary of the principal lectures and papers delivered during the past two months.

Two articles in the September issue of "Concrete" may claim special attention; i.e., the one dealing with reinforced concrete as applied to the National Gallery, London, and the other dealing with reinforced concrete as applied to a torpedo station in the Mediterranean.

Special articles include one on "earthquake-proof" buildings of reinforced concrete, and considerable space has been devoted to the experimental work that has been carried on at home and abroad in connection with reinforced concrete.

**Tungsten Ores in Canada.**—A Report on the Tungsten Ores of Canada, by Prof. T. L. Walker, of Toronto University, has just been issued by the Mines Branch of the Department of Mines of Canada at Ottawa. The Report covers 50 pages and includes 15 illustrations.

Amongst the rare metals which have recently become of commercial value, tungsten is an important example. One of its most recent applications is as a filament in incandescent lamps, in which it gives a much more brilliant light with greater efficiency than carbon. Its most important use, however, is in the manufacture of tungsten steel, to which it imparts great elasticity and tensile strength. The metal has, therefore, become particularly valuable to the manufacturers of special steels. The known occurrences of tungsten ores throughout the world are comparatively few, which fact lends additional interest to some discoveries of scheelite (an ore of tungsten) which have been made within the past year or two in Nova Scotia. These, together with other occurrences of tungsten ores in Canada, have been made the subject of the present report, which is designed to present to those interested all the available information on these ores.

## PUBLICATIONS RECEIVED.

**Manual of the Engineer's Solar Transit.**—A valuable, pocket-sized publication, just issued by the Keuffel & Esser Company of Hoboken, N.J., a firm known the world over for reliable surveying instruments. The contents include a description of the transit, its adjustments, and methods of use, table of mean refractions, rules for taking the sun at any latitude or longitude, tables regarding the correction of azimuth errors, directions for determining the meridian by direct observation on the sun and Polaris, and other useful data. Canadian readers interested in surveying may address inquiries to the publishers' Montreal office, where they will be cheerfully and promptly attended to.

**Modern Methods of Street Cleaning,** by George A. Soper, Ph.D., Mem. A.S.C.E.; 6 × 9; 200 pages; 100 illustrations; price, $3 net. Published by the Engineering News Book Department, 220 Broadway, New York, U.S.A.

**The Elements of Mechanics of Materials,** by C. E. Houghton, A.B., M.M.E., associate professor of Mech. Engr., New York University. 200 pp., 6 × 9; price $2. Published by the D. Van Nostrand Company, 23 Murray Street, New York City, U.S.A.

**The Protection of Railroads from Overhead Transmission Line Crossings,** by Frank S. Fowle, S.B., consulting electrical engineer; 70 pages, 6 × 9. Price, $1.50. Published by the D. Van Nostrand Company, 23 Murray Street, New York, U.S.A.

**Electric Power Conductors,** by William A. Del Mal, A.C.G.I., assistant engineer, Electrical Transmission Department, N.Y. Central Railway; 330 pages, 6 × 9; price $2. Published by the D. Van Nostrand Company, 23 Murray Street, New York, U.S.A.

## CATALOGUES.

**Electrical Supplies.**—Section 2; second edition; issued by the Canadian General Electric Company, Toronto. This is a handsome, 100-page catalogue, devoted to cabinet panels, cut-outs and fuses. Illustrations and prices of all types of this apparatus are given in a volume which should be on the file of every purchasing agent.

**Pumping Machinery** for Waterworks is described in an elaborate volume which is being distributed by the Fred. M. Prescott Steam Pump Company of Milwaukee, Wis., in honor of the American Waterworks Association's twenty-ninth annual convention, held at Milwaukee, June 7-12. Profuse illustrations of many types of pumping engines are given in a piece of work which represents the printer's best.

**Cements** and their uses are described and illustrated in the 8th edition of the Smooth-on Manufacturing Company's instruction book, just issued. If you desire a copy, with the publishers' compliments, drop a postal to their head office, Jersey City, N.J.

**Contractors' Equipment.**—From the Montreal office of Mussens, Limited, come interesting bulletins devoted to contractors' equipment. Mine scoop cars and dump cars, rails, buckets, rock drill steel, etc., are listed in a useful manner. Mussens have branches at Toronto, Cobalt, Winnipeg and Vancouver.

# RAILWAY EANRINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Sept. 28 | |
|---|---|---|---|---|---|
| | | | | 1909 | 1908 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,763 000 | 2,104.000 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 375.900 | 313,900 |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 1,179,150 | 1,050.980 |
| T. & N. O. | 334 | (Gov. Road) | ..... | 50,050 | 26,536 |
| Montreal Street Railway | 138 3 | 18,000 | 100 | 75,185 | 70,911 |
| Toronto Street Railway | 114 | 8,000 | 100 | 73,875 | 67,655 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... |

STOCK QUOTATIONS

| TORONTO | | | | | MONTREAL | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Price Oct. 1 '08 | Price Sept. 23 '09 | Price Sept. 30 '09 | Sales Week End'd Sep. 30 | | Price Oct. 1 08 | Price Sept. 23 09 | Price Sept. 30 '09 | Sale Week End'd Sep. 30 | |
| 177¼ | 176¼ 182¼ | 182 186¼ | 186¾ | 736 | 177 | 176¼ 182¼ | 182 186¼ | 186 | 2459 |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | *1st. pref 108¾, 3rd pref. 68½, ordinary 24¾ | | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | 215 | 214½ 214½ | 214 | 238 |
| 102 | 100 124½ 161 187¾ | 124 126½ | 126 192 187½ | 689 135 | 101½ 162¼ | 101 124¼ 161¾ 167¾ | 124¼ 126½ 187½ | 126 | 1611 10 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.

## GUELPH RADIAL RAILWAY COMPANY, LIMITED.

President, Mr. J. W. Lyon.
General Manager and Purchasing Agent, Mr. J. J. Hackney.
Chief Engineer,

**Kind of Road:** Street Railway.

**Length of Road, in miles:**

Single track, 6.
Total in single miles, 6.

**Character of Service:**

Car equipment, No., 14.
Number of motors, 30
Power of motors, 25 h.p.
Method of braking, hand.
Gauge of track, standard.
Weight of rails, 60 lbs.

**Power:**

Direct current, D.C.
Voltage of transmission, 550 volts.
Trolley voltage, 550 volts.

## GALT, PRESTON AND HESPELER RAILWAY.

President and General Manager, Mr. M. N. Todd, Galt.
Secretary-Treasurer and Purchasing Agent, Mr. W. H. Lutz, Galt.
Superintendent, Mr. M. W. Kirkwood, Preston.
General Freight and Passenger Agent, Mr. C. J. Whitney, Preston.

**Kind of Road:** Interurban and Street Railway.

**Length of Road:**

Single track, 6.
Double track, 2 miles.
Total in single miles, 21.

**Equipment:**

Closed cars, double truck, 6; four 65 h.p. motors.
Open cars, double truck, 1; four 45 h.p. motors.
Closed cars, single truck, 2; two 35 h.p. motors.
Open cars, single truck, 1; two 35 h.p. motors.
Freight locomotives, 2,; four 65 h.p. motors.
Steam locomotives, 1.
Method of controlling, unit switch control.
Method of braking, automatic air brakes.
Gauge of track, 4 ft. 8½ in.
Weight of rails, 65 lbs., and 70 lbs.

**Power:**

Direct current.
Alternating current transmission, 6,600 volts, 25 cycle, 3 phase.
Current collecting devices, over-head trolley.

## EDMONTON STREET RAILWAY.

The earnings and other figures relating to the operation of the Edmonton Street Railway for the past three months are as follows:—

| | Earnings. | Passengers Carried. |
|---|---|---|
| September | $8,816 | 209,920 |
| August | 8,002 | 194,704 |
| July | 8,721 | 204,584 |

In July two extra cars were placed in operation on the system, and in September two more were placed in commission, making 11 in all.

## RAILWAY ACCIDENTS.

(Continued from page 393.)

### Notes of Wrecks.

At Fernie, B.C., five coal cars on a G.N.R. train were ditched and completely ruined. Cause, broken rail.

The caboose of a C.N.R. freight train was derailed near Brandon, Man., and line was blocked for six hours.

Several derailed cars near Smith's Falls, Ont., delayed a C.P.R. passenger train two hours.

A C.N.R. passenger train was delayed eight hours by a wrecked freight train near Kamsack, Sask.

Several hours' delay resulted through the wreck of a freight train on the Grand Trunk, near Aylmer, Ont., caused by a broken axle.

A street car in Vancouver jumped the tracks and fell into a trench which was being excavated in connection with paving work. Considerable damage resulted but no one was hurt.

Three cars were demolished and much damage was caused to the engine of freight through a broken coupling. A passenger train ran into the freight before the latter was able to get clear.

Three hundred dollars damage was the result of a rear end collision between freight and passenger trains at Burketon Junction, Ont.

Twelve hours' delay was caused by a wreck on the C.N.R. near Port Arthur, in which three cars of grain were spilled.

Six cars were ditched at Georgetown on the G.T.R. through a collision at a cross-over diamond between two freights. Estimated damage, $3.000.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received until noon of Wednesday, October 13th, for the construction of the Steel Work, Concrete and Masonry, and Reinforced Concrete Flooring and Paving of the St. Catherine St. bridge. L. O. David, City Clerk.

MONTREAL.—Tenders will be received for an electrically-driven waterworks pump, with a capacity of 1½million gallons per day, for the Saraguay Electric and Water Company, and for six 250 k.w., and three 500 k.w., 11,000 volts transformers. Mr. Charles Brandeis, consulting engineer, 4 Phillips Place, Montreal.

QUEBEC.—Tenders will be received until Friday, October 22nd, for the construction of an Ice Breaker at St. Liguori, Montcalm County, Que. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

QUEBEC.—Tenders will be received up to 4 p.m. on Monday, the 11th October for trenching and refilling in part of Champlain Street. J. Gallagher, Waterworks Engineer.

**Ontario.**

BARRIE.—Tenders will be received until Monday, October 11th, for the material and work of constructing 1,900 feet of sewers. E. Donnell, clerk; C. H. and P. H. Mitchell, consulting and supervising engineers, Traders Bank Building, Toronto. (Advertised in the Canadian Engineer.)

BERLIN.—Tenders will be received until Thursday, October 28th, for paving King Street. A. H. Millar, town clerk; Wm. Mahlon Davis, C. E., town engineer. (Advertisement in the Canadian Engineer.)

HAMILTON.—Tenders will be received for the several works required in the erection and completion of an office and warehouse building for the W. A. Freeman Co. A. W. Peene, architect.

NEW LISKEARD.—Tenders will be received until October 15th, for a sewerage system. H. Hartman, town clerk, C. H. Fullerton, town engineer. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until October 11, for supplying the material required in the reconstruction of the Ontario parliament buildings. Mr. J. O. Reaume, Minister of Public Works, Toronto. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will shortly be invited for two new steam fire engines for the city of Toronto.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, October 11th, for the construction of sewers in the township of York. Barber & Young, York Township Engineers, Toronto. (Advertisement in the Canadian Engineer.)

LATCHFORD.—Tenders will be received until Thursday, October 28, for the construction of a Dam and Sluiceways across the Montreal River at Latchford. Plans and specifications can be seen at the office of J. G. Sing, district engineer, Confederation Life Building, Toronto, and on application to the Postmaster at Latchford. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

BRANTFORD.—Tenders will be received until October 12th for pavements. T. Harry Jones, city engineer. (Advertised in the Canadian Engineer.)

**Manitoba.**

WINNIPEG.—Tenders will be received up to Monday, 11th October, for erection of foundation of all concrete work for overhead crossing, with pile and timber approaches, at Sixth Avenue, Moose Jaw. Plans and specifications may be seen at office of C.P.R. assistant chief engineer, Winnipeg; division engineer, Calgary, or resident engineer, Moose Jaw.

**Alberta**

MEDICINE HAT. — Tenders will be received by the Chief Engineer of the Southern Alberta Land Co., until October 14th, for the construction of an Earth Dam across Snake Valley, containing about 110,000 cubic yards and for about 16 miles of canal, averaging about 50,000 cubic yards per mile. The work is situated close to Little Bow River in township 14 and 15, range 21, west of the 4th meridian. Bids will be received for all or any part of the work.

**Saskatchewan.**

ELBOW.—Tenders will be received up to October 11th, for the erection of a pump house and tank for the village of Elbow. B. Longmore, secretary.

MAPLE CREEK.—Tenders will be received until October 15th for sewage pumping equipment. H. A. Greeley, secretary-treasurer; C. M. Arnold, consulting engineer, Lethbridge. (Advertisement in the Canadian Engineer.)

**British Columbia.**

VICTORIA. — Tenders will be received up to 4 p.m., Monday, 15th November, for supplying 20 tons of best blue pig lead. W. W. Northcott, purchasing agent.

VANCOUVER.—Tenders will be received until October 25th for building a large bridge over False Creek, this city. sulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

## CONTRACTS AWARDED.

**New Brunswick.**

FREDERICTON.—Hon. John Morrissy, Chief Commissioner, awarded the following bridge contracts, which were opened at the Public Works Department last week. Hatfield bridge, Simonds, Carleton Co., to W. R. Fawcett, Temperance Vale, $900; Dingey bridge, Simonds, Carleton Co., to Aaron Shaw, Peel, Carleton Co., price in the vicinity of $600; Ellis bridge, Brighton, Carleton Co., to W. R. Fawcett, contract price, $1,500; Maugren bridge in Brighton, Carleton Co., has been awarded to W. R. Fawcett; the figure is $1,800.

**Nova Scotia.**

NORTH SYDNEY.—Extensive orders for mining plant have been placed by the Colonial Coal Co., Ltd., of North Sydney. Engines have been purchased from E. Leonard & Sons, of London, Ont., and hoisting plant from Mussens, Limited, of Montreal.

**Quebec.**

QUEBEC.—Mr. E. G. M. Cape, of Montreal, was the lowest tenderer for the technical school which will be erected by the Quebec government and modelled after that now in course of construction in Montreal. Several days after the tenders were opened, a local firm offered to erect the building for $223,000. This is $12,000 less than the figure submitted by Mr. Cape. The situation has caused trouble among the members of the special school commission, some of whom are in favor of accepting the local firm's tender, while the others think the contract should be given to Mr. Cape.

MONTREAL.—The contract for a 500 k.w. steam turbo-generator for the Saraguay Electric & Water Co., has been placed with the Canadian General Electric Co., of Toronto. Delivery will be made in time for the coming winter service. Mr. Chas. Brandeis, of Montreal, was the consulting engineer.

MONTREAL.—A contract was signed here on September 30 by the Mexican Northern Light and Power Company with the big English contracting firm of Sir Whitman Pearson & Sons, for the construction of a dam, power plant and twenty miles of railway on the Conclas River for about $5,000,000, the work to be completed in three years.

MONTREAL.—Work will be begun at once on the C. P. R. bridge between St. Johns and Iberville, spanning the Richelieu River. The bridge will be 1,500 feet long. There will be a lift span in the centre. The Government intends widening the river at this point and already the dredging is well under way. Although a double track will not be installed at once, provision will be made for double tracking the bridge. The contract for the sub-structure has been awarded to Messrs. Quinlan and Robertson, of Montreal.

VERDUN.—Mr. I. Collins, of Montreal, has secured the contract for the new power house here, the work of erecting which is being supervised by Mr. Charles Brandeis, consulting engineer, Montreal.

HULL.—The tender of Messrs. Carriere & Wilson for the excavations of the waterworks extension, which is to cost $22,000, was accepted.

**Ontario.**

OTTAWA.—Messrs. Henry Smith and J. J. Heney of this city have been awarded a contract from the public works department to build a large dock at Mission river, near Fort William. The contract is in the neighborhood of $350,000. The docks are to be erected in connection with the construction of the Grand Trunk Pacific railway and, as can be judged from the estimated cost, will be of very large size.

TORONTO.—Among the contracts let recently by the Hydro-Electric Commission were those for the supply of cranes. Royce & Company, of Ancaster, England, got the contract for the electric cranes and Mussens Limited, of Montreal and Toronto, that for nine hand cranes. The amounts aggregated $16,575. In each case the lowest tenderer was awarded the contract. This completes all the contracts to be let for the mechanical work of the transmission lines.

**British Columbia.**

VICTORIA. — Messrs. Gore and McGregor have received a contract from the American Securities and Finance Co., who recently purchased from the C. P. R., large timber areas in the Cowichan district, to run boundary lines in connection with the delimitation of the land. The C. P. R. will probably build a branch line in this neighborhood as a result of the deal.

VANCOUVER.—A contract was awarded to Messrs. Cleveland & Dutcher, civil engineers, of Vancouver, for the engineering work in connection with the construction of a complete irrigation system at Richlands, Okanagan Valley, which involves an area of 3,750 acres.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

CHICOUTIMI.—The Chicoutimi Pulp Company recently gave out contracts for the construction of an electric railway from their mills into the limits in the River du Moulin district. These limits are only of use with such a railway as the rivers flowing through them are not large enough to "drive" any considerable number of logs and it is in order to get the wood from them that this line will be constructed. It is thought that at some future date this line may be continued into the River a Mars limits, thus joining the village of St. Alphonse with Chicoutimi and the Quebec & Lake St. John Railway.

**Ontario.**

LONDON.—Extensions to the roundhouse and yards of the C.P.R. at this point have been decided upon.

LONDON.—The C.P.R. have just completed the relaying of the entire line between London and Windsor with new 85-lb. rails.

OTTAWA.—Construction work has been commenced by the G.T.R. on a bridge over Preston Street. It will be a girder structure with concrete piers. Estimated cost, $18,000.

OTTAWA.—The Department of Railways have approved the route map of the new line of the Canadian Northern Railway from Toronto to Ottawa via Smith's Falls. The Canadian Northern has agreed to build a branch line to Lanark.

OTTAWA.—The Chatham, Wallaceburg, & Lake Erie Railway Company have been refused by the Board of Railway Commissioners permission to construct a branch line to a point opposite Grand Ligne.

OTTAWA.—Railway charters will be asked at the next session for the following projects: To incorporate the Pine Pass Railway Company; to build from Edmonton through the Pine River Pass to Fort George, B.C. The Manitoba and North-Western Railway Company; to build from Birtle to Hamiota, Man., and from Russel, Man., 150 miles northerly or north-easterly. The Calgary and Edmonton Railway Company; to extend its Lacombe branch 200 miles to join the C.P.R. Moose Jaw branch at Outlook. Extensions of time will be asked as follows: By the Columbia and Western Railway Company, in regard to its second, fifth and sixth sections; The Manitoba and North-Western Railway Company; The Kamloops and Yellowhead Pass Railway Company; The Esquimault and Nanaimo Railway Company, for its Comox extension and branches; The Nicola, Kamloops and Similkameen Coal and Railway Company; The Edmonton, Dunvegan and British Columbia Railway Company.

ORILLIA.—Mr. Johnson, Parry Sound, and Mr. Gordon Conyers Kirby, of Ottawa, have arrived at Atherley, where they will remain all winter in order to carry out the engineering work of the Udney-Orillia line of the C.N.O., which is being commenced this week. It is also believed that the C.P.R. will build their swing bridge at the Narrows during the coming winter.

**Manitoba.**

VIRDEN.—Track laying has been commenced on a 15-mile extension of the C.P.R. which runs north-west from here.

WINNIPEG.—It was announced this week that the Government will commence the construction of the Hudson's Bay Railway this fall. Surveys of the first section are already completed.

BRANDON.—A number of men previously employed by the C.N.R. on construction work in the Goose Lake district are being transferred to Maryfield, near Brandon, where the railway company have 125 miles of steel to lay. A long train bearing the gear and men passed through the C.N.R. depot this week, and the work will commence immediately upon their arrival at the destination.

WINNIPEG.—Work is being pushed forward rapidly on the G.T.P. branch lines. About twenty miles of steel have already been laid on the Melville-Regina extension, and the balance of the steel to Balcarres will be completed in about a week's time. This is as far as the grade will be completed this fall. On the Melville-Yorkton branch the steel has been laid for six miles, and the line will be completed in a month. Grade work on the Tofield-Calgary line is progressing favorably, and should the weather continue fine it will be constructed as far as Camrose this fall, a distance of 50 miles.

**Alberta.**

CALGARY.—In a recent interview, Mr. Cecil Goddard, engineer of the Canadian Western Railway said that the company had decided upon a line into Calgary. The railway will cross the High River a distance from the town of High River, and the company expect to have the line completed in two years.

**Saskatchewan.**

VONDA.—The C.N.R. have over one hundred men here, raising the main track eighteen inches and putting in an additional siding Extensive repairs will also be made to the station. The object of thus grading the road is to prevent snow drifts similar to those of former winters.

**British Columbia.**

NEW WESTMINSTER.—Reports received from Chilliwack are to the effect that work is being pushed along at an exceptionally rapid rate on the last section of the Westminster-Chilliwack tram line extending from Abbsotford to the Valley City. The contractors are all working under time limits, and in addition to large gangs of men they have extensive machinery plants in operation. It is expected that gradings will be completed within sixty days, while the line will probably be opened early next year.. The rails have already been laid from this city almost to Cloverdale—15 miles.

VANCOUVER.—The Canadian Northern Railway has filed plans of survey for the first 54 miles north of Kamloops. A grade of less than one-fifth per cent. from the Yellowhead Pass to Kamloops has been secured.

NEW WESTMINSTER.—The British Columbia Electric Company are planning to erect a building which, when completed, will be the finest structure in this city. They will also extend their car shops.

VANCOUVER.—The contract for building the extension of the branch of the E. & N. railroad from the end of the present line to Alberni, 27 miles, has been awarded to the Calgary firm, Janse, McDonnell & Timothy. The successful firm were the lowest tenderers, the next lowest being Macdonell, Gzowski & Company, of Vancouver. Work on the extension will be started within a few days.

## LIGHT, HEAT, AND POWER

**Quebec.**

MONTREAL.—The Saraguay Electric and Water Company are duplicating their line from Cartierville to Notre Dame de Grace.

VERDUN.—On Monday, October 4th, tenders closed for electric light plant, the installation of which is in charge of Mr. Charles Brandeis, consulting engineer, Montreal.

**Ontario.**

TORONTO. — Last Thursday, the concluding meeting of the engineers representing the general municipalities that have subscribed for Niagara power held their concluding meeting, with Mr. R. A. Ross, of Ross & Holgate, consulting engineers, of Montreal, in the chair. With a view to fixing rates which they are to be charged by the Hydro-Electric Commission, the engineers decided to furnish the power commission with full particulars regarding the present conditions in their cities. It is expected that the Hydro-Electric Commission will deliver power in Toronto and several other cities with which they connect by next March.

COBALT. — The contract for sixty transformers and switchboards in sizes of 160 K.V.A. and less, for the Cobalt Power Company, has been awarded to the General Electric Manufacturing Company of Sweden, through their representatives, Messrs. Kilmer, Pullen & Burnham, Toronto.

**Foreign.**

RJUKAN (NORWAY).—The contract for what is believed to be the largest generators in the world was recently awarded to the General Electric Manufacturing Company of Sweden. The five generators are to be supplied for the Rjukan Saltpeter Plant in Norway, and are each of 23,000 electrical horse-power, 11,000 volt, 50-cycles, 250 R.P.M., of the horizontal water-wheel type, totally enclosed and ventilated by the revolving field which acts as a fan. Canadian representatives: Kilmer, Pullen & Burnham.

## SEWERAGE AND WATERWORKS.

**British Columbia.**

VICTORIA.—Mr. Arthur L. Adams, the city's water expert, and Mr. Ashcroft, assistant engineer, recently reported on the cost of bringing water from Sooke Lake. Two schemes were submitted. To bring the water by a tunnel, the distance would be 17.4 miles, while if a pipe line were decided on, the distance would be 2.72 miles. The estimated cost of the tunnel route, as given in Mr. Adam's report is $1,098,900, and the alternative route $1,064,000. It would take four or five years to install the plant and build the tunnel, which would be designed to carry 7½ million gallons daily. The cost of acquiring the lands and right-of-way would be $100,000. Mr. Ashcroft thinks that estimate too low. His estimate of the cost of a tunnel route is $2,236,500, and the alternative route $1,663,000. These figures include $150,000 for the lands.

VANCOUVER.—Details of the plan to provide South Vancouver, Point Grey and Richmond municipalities with water from Seymour Creek at an initial cost of $500,000 were placed before the municipal council of Burnaby last week in a report by Messrs. Cleveland & Dutcher, civil engineers, of Vancouver. A special committee was appointed to go carefully through the report.

SOUTH VANCOUVER.—A by-law has been submitted to the ratepayers of the municipality with a view to bringing water from Seymour Creek at an estimated cost of $225,000. It would take two years to install the system proposed, which would be capable of supplying nine million gallons a day.

PRINCE RUPERT.—The plans for the proposed municipal waterworks system have been approved and returned from Victoria, and the work is now under way. The work will be rushed by the engineer in charge, Mr. A. W. Agnew. Over one and a half miles of feed pipe from the source of supply to the reservoir have been laid. There will be eighty miles of mains. A flat rate of $5 a yard for rock and 55 cents for earth has been secured, which will make the job less expensive than any work yet done.

## CEMENT—CONCRETE.

**Ontario.**

OTTAWA.—Concrete piers will form part of a new $18,000 bridge which the Grand Trunk will shortly erect over Preston Street here.

PETERBOROUGH.—The work of erecting the new power house, which is being done by the Bishop Construction Company is progressing favorably, and it is expected that the building will be completed in five weeks. Work on a concrete dam will commence shortly.

**Quebec.**

MONTREAL.—Until Wednesday, the 13th October, Mr. L. O. David, city clerk will receive tenders for concrete and masonry work and reinforced concrete flooring in connection with a bridge to be erected at St. Catherine Street.

## TELEPHONY.

**British Columbia.**

CRESTON.—The Creston Power, Light & Telephone Company is now putting the finishing touches to its new telephone system. Altogether there are about fifteen miles of line hung. The electicians have installed the new switchboard and distributor in the company's new head office. This company has also run private lines through the town and many suburban lines are now in operation.

## CURRENT NEWS.

**Manitoba.**

BRANDON.—City Engineer Speakman is preparing plans for a subway which the city proposes to build under the C.P.R. and G.N.R. tracks. The cost is roughly estimated at $100,000.

**Yukon.**

DAWSON.—The Yukon Gold Coy.'s. great ditch, extending to Goldhill, has been completed, and on September 23rd water was turned into it. The water is conveyed from Twelve Mile River, 70 miles from the place of its use. A volume of 5,000 inches is sent over the hills at a cost of $10,000,000, making the successful consummation of what is probably the greatest engineering undertaking in the history of the far north.

## PERSONAL NOTES.

MR GEORGE C. GERTH., formerly of Port Pelly, Sask., is now located at Canora, Sask.

MR. G. C. McKAY'S appointment as engineer was confirmed at a recent meeting of the City Council of Nelson, B.C.

MR. J. W. PORTER, formerly assistant engineer on the Toronto-Sudbury branch of the C.P.R. has been transferred to the National Transcontinental Railway at Quebec.

MR. GEORGE A. BROWNE, of the National Transcontinental Railway, has changed his address to Residence 15 of the N.T.R. at Cochrane, Ont. He was formerly at North Bay.

MR. CHARLEIS BRANDEIS, who has a large consulting practice in Montreal, where he has offices at 4 Phillips Place, was recently appointed consulting engineer to the Colonial Coal Company, Ltd., of North Sydney, N.S.

MR. P. H. MITCHELL, consulting engineer, of Toronto, has returned from a business trip to New York. Mr. Mitchell says the American manufacturers are watching Canada's development with great interest.

MR. H. SHEARER, of Detroit, has been appointed division superintendent of the Canadian lines of the Michigan Central Railway, with headquarters at St. Thomas, to succeed Mr. Adams, who takes the general superintendency of the Toronto, Hamilton, and Buffalo Railway at Hamilton.

MR. H. K. DUTCHER, M.Sc., A.M. Can. Soc. C.E., who was until recently a member of the firm of Cleveland & Dutcher, has opened offices in the Winch Building, Vancouver, B.C., where his large consulting practice will be carried on. Mr. Dutcher was formerly located in the Flack Block.

MR. A. N. ADAMS, division superintendent of M.C.R. at St. Thomas for the past seven years, has been appointed general superintendent of Toronto, Hamilton and Buffalo, with headquarters at Hamilton, succeeding Mr. E. Fisher, who is leaving on account of ill-health. Mr. Adams is a native of Detroit, 35 years of age, a graduate of Johns Hopkins University and Massachusetts Institute. He was draughtsman on M.C.R. in 1890, assistant engineer in 1901, assistant chief engineer in 1902, and later assistant superintendent at Detroit.

## OBITUARY.

MR. N. A. RHODES, vice-president of the Rhodes-Curry Company, Ltd., Amherst, N.S., died on September 30th. Mr. Rhodes was 64 years of age, and had been in business in Amherst for nearly forty years.

MR. JAMES H. SUTHERLAND, roadmaster of the Brandon-Regina division C.N.R., died at his home Brandon, Man., September 26, 1909. Mr. Sutherland was forty-three years of age and a native of Fredericton, N.B.

## MARKET CONDITIONS.

Montreal, October 7th, 1909.

Latest reports from the United States, on pig iron, are to the effect that the strength commented upon in the Canadian Engineer for some time past has more than been realized. It would seem that all records for the output of iron were smashed in the month of September. This certainly was the case with steel-making iron, and probably with foundry. Stocks of pig iron, to-day, in the various producing centres, slightly exceed 1,000,000 tons, the significant feature being that at these figures they have decreased not far from 500,000 tons. This is one of the most encouraging features of the market, inasmuch as it indicates an enormous consumption. Contracts during the month of September are said to have reached 1,000,000 tons. Consumers outside the steel companies cootracted for 600,000, this being the largest tonnage of foundry iron ever placed under contract during a single month. It was a little significant, however, that during the latter part of the month, the buying movement showed a falling off as compared with the earlier portion.

In finished steel products, transactions were less heavy during September than during the previous few months, but in steel rails the aggregate was heavy, being 700,000 tons, which was the heaviest month in two years. The tendency of prices is still upwards, and 50c. per ton has been added during the past week, all round.

There is not a very great deal happening in the English and Scotch markets, but the tendency of prices is entirely in an upward direction. Apparently, considerably more metal is being sold for prompt delivery and is going into immediate consumption. Warrant prices have advanced about 9d. during the week, with an indication of higher prices being asked, as the result of increasing cost of ore and fuel, and also in view of the possibility of exports from the United States. The Scotch makers are well situated and are holding their output for prices which are fully 8s. above the low figures for last June. Hematite, the steel-making iron, which has been in poor demand for many months past, has taken a turn very much for the better. Consumption is rapidly increasing and prices have gone up about 6s. in the past three weeks. These advances on raw material will undoubtedly have the effect of increasing the cost of finished material in proportion thereto. As a rule, however, the advance in finished products does not come for some little time after raw material has started to move up.

In the local market, the situation continues very strong. Supplies are practically exhausted. Canadian furnaces are well sold ahead, and as a consequence are not anxious to do new business. Consumers requiring material do not seem to hesitate to pay the prices demanded, it being apparently their opinion that delay will only make the situation worse for them. Furnace people do not hesitate to declare that the next six months will see prices $1.50 to $2 per ton higher than they now are, for delivery in 1910. Offers to purchase at a fraction below the market are receiving little consideration from holders.

There has been a general advance in local pig iron prices, as will be seen from the following list. Notwithstanding the strength of the pig-iron situation, however, merchants handling finished and semi-finished iron and steel products fail to find the strength uniform throughout their markets. Steel plates, for instance, are almost easy in tone and it is quite possible that the prices quoted for some time past would even be shaded. In bar iron and steel, however, the situation is otherwise, and the mills report that advances are not far away. Following is the list of prices:

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¾-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19 to $19.50; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50, and No. 3 $19, for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20. to $21.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.00 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being ½-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized, ¾-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; 1-inch, $8.50, with 69 per cent. off for black, and 57 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; 1¼-inch, $11.50 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50 3-inch, $85.50; 3½-inch, $98; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.2 for ⅜-16; $2.30 for ¼, and $2.10 for ¼ and thicker; 12-gauge being $2.30 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, October 7th, 1909.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¾-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur. This has been the case since September 16th. There is a good deal moving and the likelihood felt that the merger is unlikely to boost prices beyond a living point, will probably cause the free movement to continue. Smaller dealers get $1.50 per barrel without bags, in load lots, delivered in town.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is laregly used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—gauge, $4.50; 20-gauge, $4.25; per 100 lbs. Demand very active and prices advanced 10c.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.10; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Talk is still heard of an advance, but nothing definite.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—Although prices are stiffening generally, there is no freedom in buying shown by country dealers in Ontario, who continue to order

"from hand to mouth." It is the city trade building being still active, which still absorbs the attention of producers or large merchants. Some sizes of native pine, for example, 2-inch good and 10 x 12 inch stock, are becoming scarce. British Columbia shingles are easier; everything else on the list appears to be on the upward trend according to outside advices. The almost wonderful demand from builders in the city, however, continues, and the keen competition to fill it makes the market almost a buyers' one. We quote dressing pine $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—An improved request is noted lately, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10x16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9¼c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.—**

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots, 65 per cent. of list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

### CAMP SUPPLIES.

**Beans.**—Hand picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods.**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 6 to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6¼ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Scarce and higher. Tierces, 15¼c.; tub, 15½c.; pails, 15¾c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 75c. a bag.

**Pork.**—Still advancing. Short cut, $27.50 per barrel; mess, $26.

**Rice.**—B grade, 4½c. per lb.; Patna, 5¼ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.


# SHEETS!

Aluminum Lead
Brass Tinned
Copper Zinc

At lowest prices for prompt deliveries.

**A. C. LESLIE & Co., Limited**
**MONTREAL.** 7


**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, October 4th, 1909.

Quotations are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard, large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4¼c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.95.

**Picks.**—Clay, $5 per dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

**Pipe.**—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

**Pitch.**—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c.; sisal, 10½c.

**Spikes.**—Basis as follows:—1¼ 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 100 lbs.

**Timber.**—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Tool Steel.**—8½ to 15c. per pound.

**Wire.**—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 gauge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.

# TENDERS CALLED FOR

## TURBINE PUMPS.

**EXTENSION OF TIME.**

Tenders will be received by the City of Toronto, Canada, up till noon of Thursday, October 28th (changed from October 14th), for the following Turbine Pumps:—

| | | | | | | |
|---|---|---|---|---|---|---|
| 4— | 13½ | million | gallon | pumps. | 100 | pounds pressure. |
| 2— | 5 | " | " | " | 300 | " " |
| 2— | 10 | " | " | " | 65 | " " |
| 2— | 10 | " | " | " | 110 | " " |
| 2— | 6½ | " | " | " | 90 | " " |
| 2— | 6½ | " | " | " | 160 | " " |
| 2— | 1½ | " | " | " | 65 | " " |
| 2— | 1½ | " | " | " | 110 | " " |

With valves, piping, bed plates, couplings, etc.

The lowest or any tender not necessarily accepted.

For specifications and form of tender apply to the City Engineer.

## ELECTRIC MOTORS.

**EXTENSION OF TIME.**

Tenders will be received by the City of Toronto, Canada, up till noon of Thursday, October 28th (changed from October 14th), for the following Electric Motors:—

4—1500 H.P. Synchronous Motors.
2—1500 H.P. Induction Motors.
4— 500 H.P. Synchronous Motors.
4— 500 H.P. Induction Motors.
2— 225 H.P. Synchronous Motors.

With exciters, switchboards, connecting material, etc.

The lowest or any tender not necessarily accepted.

For specifications and form of tender apply to the City Engineer.

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The city of Toronto, Canada, will shortly call for tenders for pole line supplies, including poles, cross-arms, pins, braces, etc., etc.

For information apply Electrical Department, City Hall.

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## SUPPLY OF PIPE.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on **Tuesday, November 16th, 1909,** for the supply of three thousand feet of rivetted steel pipe 60 inches in diameter, and five hundred feet of rivetted tapered steel pipe, also one thousand seven hundred and eighty-two lineal feet of 6-inch reinforced concrete pipe for the outfall sewer.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the City Engineer, Toronto.

The usual conditions relating to tendering as prescribed by city by-laws must be strictly complied with, or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

JOSEPH OLIVER (Mayor),
Chairman, Board of Control.

City Hall, Toronto, Oct. 1, 1909.

## CITY OF MOOSE JAW, SASK.

**Tenders for Water Meters.**

Sealed tenders addressed to Alderman Matthews, Chairman Water and Sewer Committee, will be received in the Council Chamber, up to 8.30 p.m., Monday October 11th, 1909, for 50 5/8" Water Meters and connections complete, delivered F.O.B., Moose Jaw, Saskatchewan.

J. DARLINGTON WHITMORE, City Engineer.

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## TOWN OF MAPLE CREEK

Tenders will be received by the secretary-treasurer of the town of Maple Creek, Saskatchewan, until October 15th, 1909, for the delivery and erection of Sewage Pumping equipment, approximate capacity 350 gals. per minute.

Plans and specifications may be seen at the office of the secretary-treasurer, Maple Creek, or at the office of C. M. Arnold, Consulting Engineer, Lethbridge, Alta.

A certified check for 10% of the amount of tender, payable to the secretary-treasurer of the town of Maple Creek, must accompany each tender as a guarantee that the successful tenderer will enter into a contract.

No tender necessarily accepted.

H. A. GREELEY,
Secretary-treasurer.

Maple Creek, Sask., September 21st, 1909.

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## TO QUARRYMEN, BRICK MANUFACTURERS, SUPPLY MEN ETC.

Tenders will be received by the Minister of Public Works, until 3 p.m. on Monday, October 11th, for the supplying of the under-mentioned materials in connection with the erection and reconstruction of the portion of the Ontario Parliament Buildings, Toronto, recently destroyed by fire.

Tenderers will be requested to estimate for the supplying of the material in quantities as may be required from time to time, viz.:

(1) For Hard Building Brick, per thousand.
(2) For Red Credit Valley Stone, per superficial yard, suitable for random masonry work, similar to what has been formerly used in connection with the erection of the Buildings. Stone to bed from about 9 to 14 inches.
(3) For Red Credit Valley Stone in promiscuous sized blocks, per cubic foot.
(4) For Red Credit Valley Stone, in dimension blocks, per cubic foot.
(5) For Building Sand, per cubic yard.
(6) For Grey Lime, per hundred pounds.

The whole of the above materials must be of first-class quality, subject to the approval of the Architect. The prices submitted, must include all charges, such as freight, cartage, handling etc., necessary to deliver material upon the works.

Plans of the present buildings and all other information can be had at the offices of the Architect, E. J. Lennox, 164 Bay Street, Toronto.

J. O. REAUME,
Minister of Public Works, Ontario.

Department of Public Works,
Toronto, October 2nd, 1909.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, OCTOBER 15th, 1909. No. 15

## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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**ADVERTISEMENT RATES ON APPLICATION.**

**HEAD OFFICE: 62 Church Street, and Court Street, Toronto**
TELEPHONE, Main 7404.

**Montreal Office:** B33, Board of Trade Building. T. C. Allum, Editorial Representative. Phone M 1001.

**Winnipeg Office:** Room 315, Nanton Building. Phone 8142. G. W. Goodall Business and Editorial Representative.

**London Office:** 225 Outer Temple Strand T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

**NOTICE TO ADVERTISERS**

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

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TORONTO, CANADA, OCTOBER 15, 1909.

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## MUST THE YOUNG ENGINEER SERVE UNDER ARTICLES?

The old phrase, "History repeats itself," is so hackneyed that we are almost afraid to use it, but it draws attention so pointedly to a condition now developing in Canada that we may be pardoned for giving the quotation.

The profession of engineering in Great Britain, and for that matter in all European countries that have developed an engineering profession, is made up of men who served under articles in the offices of private individuals and city surveyors, or in the yards and shops of large corporations. Their terms of apprenticeship ran from three to seven years, and, in addition to becoming familiar with the routine and detail of the works, they received a certain amount, and frequently a very substantial amount, of systematic instruction of a technical nature in the scientific principles of the work on which they were engaged.

In some cases these men were college-trained men; in others, they were articled upon leaving the secondary schools. In any case they served long enough to become masters in their own right, and as a result European engineers are recognized as men, methodical, careful, able, and highly skilled in their own particular branch.

The first engineering work in Canada was undertaken by the British military engineer, and then followed a few British and foreign civil engineers anxious for adventure, and willing to neglect for the time being the finer requirements of the older lands. These men were the pioneers who prepared a body of younger men, who perforce had to accept an empirical and accidental training and carry on the work of a young country troubled with growing pains.

It is true that, coupled with all our great engineering works, we find the names of men who would have been a credit to the profession in other countries. Strong men, true artists. But the rank and file were pressed or paid men.

Then came the technical college, the University Department of Applied Science, and the young graduate went forth, large in theory, small in experience. But the country was growing, the supply of engineers was limited, the work was large, and men were in great demand. The college graduate very quickly became a full-fledged engineer. If he was resourceful, his promotion was sure and rapid.

But that has changed. Ten or a dozen Canadian colleges are conducting engineering courses. The supply is a little greater than the demand, and the young man no matter how good his technical training—finds difficulty in securing a position. When he does he expects a high salary, and as a result his employment is only temporary, so that at the end of two or three years he has been under a dozen different men and on a variety of work, and yet he is not master of any one branch.

The college graduate who wishes to become a surveyor must serve one year. This term of apprenticeship will be enforced, and perhaps lengthened, and the civil engineer, who finds that just when he requires the assistant that he has trained and put in the way of experience he has lost him, will be very much inclined to bind his men under articles also.

The time is almost ripe for such a step, and when it does come it will mean the production of men more highly specialized than engineers now usually are.

The careful, systematic and long training that has made the skilled engineer of Europe will have to be adopted in this country if we wish to keep abreast of the best work in older lands.

## GUELPH AND HER PURE WATER SUPPLY.

In another section of this issue we give a detailed description of the recent additions to the water supply of Guelph, Ont.

The enlarged system was designed by Davis & Johnson, consulting engineers, Berlin, Ont., who were retained by the Guelph Water Commissioners, Messrs. G. B. Ryan, R. L. Torrence and John Newstead.

The formal opening of the new system during the last week of September was made the occasion of much speech-making, and incidentally of some editorial comment.

The system cost to date over $300,000, and now supplies water at an average cost of $9 per year for ordinary householders.

Guelph and her council and her visitors made great ado over the success that has attended their various public enterprises. Rightly so. A municipality that can handle electric light, gas, and an electric railway and show a surplus annually has much to be thankful for. We enjoyed hearing the Commissioners complimented for their loyalty and unselfish service. It is fortunate that men of prominence, ability and standing are willing to give their time and best thought to questions that concern the whole community. Hats off to the Guelph Commissioners and council, but do not let us forget the men who did the detail work. The men who accepted the responsibility for their recommendation, the men who, by continued application, by looking after the little things, worked out the success.

Guelph has a successful system, due largely to the ability and skill of William Malcolm Davis, their consulting engineer, and the aggressiveness, practical knowledge and administrative power of James J. Hackney, manager of the waterworks, lighting plant and street railway.

After all it is the men who do the work, the men that are not often in the limelight, that make public or private ownership a success. And just here we take pleasure in congratulating Guelph on being able to secure such careful, loyal municipal officials.

## THE TECHNICAL PRESS AND ADVERTISING.

The technical press, in addition to furnishing reading material and technical information for the engineer has also another field—a field just as necessary and just as useful—that of bringing closer together with the least cost the seller and buyer. It is just as necessary for the engineer to know where he can get a turbine or a generator as it is for him to know how to place it or protect it. You may design and stake out, but unless you can secure the material to build with your planning will be of little avail, and it is part of the duty of the technical press to assist in furnishing the engineer with supplies. That is why just as much care is exercised in selecting the class of advertisements that appear in a technical paper as in selecting the articles for the reading pages.

And it is just as necessary for the producer (the manufacturer) to advertise if he wishes to secure business as it is for the engineer to read and study if he wishes to maintain his position in the profession.

A couple of years ago a large Canadian firm spent several thousands annually in advertising. A year ago they cut the advertising appropriation down to as many hundreds. For a time they did not notice any falling off in business. Their firm name and their goods were well known. A year later their salesmen found enquiries dropping off; the travelling salesman found it harder to talk business. Smaller firms were advertising, getting a little of the business, first one place and then another. New buyers were in the market—buyers who did not know the older and larger firm. As a result they must spend money to regain their former field.

Another firm doing a large business with contractors cut out all advertising, trusting to salesmen in various supply houses to place their goods. In just one year they went from the top to the bottom of the list of sales of those supplies in Canada.

Not long ago a salesman for storage batteries—a former advertiser—called and said: "Why do you take our competitor's advertisement? For years we carried an advertisement with you. They are newcomers. We have quit, 'tis true, but only for a short time. The worst part is we have **not made a single sale** since we quit and the other fellows commenced."

The right kind of advertising, like the right kind of technical literature, is read, and if not immediately used is put by for reference, and the right kind of engineer reads advertisements as well as editorial matter.

## EDITORIAL NOTES.

Over eight million dollars worth of new buildings have gone up in Winnipeg during the last nine months.

* * * *

October the 1st saw the tides in the Peticodiac River, N.B., higher than at any time since October 4th, 1869. Great damage has been done in districts bordering Fundy Bay. Dykes have been broken down and much marsh hay land flooded.

* * * *

Mr. A. W. Campbell, Deputy Minister of Public Works for Ontario, has been for years carrying on a campaign on behalf of "good roads." First and always he has endeavored to educate the municipalities to adopt the best in management, design and construction. Mr. Campbell has made good as an educationalist (on roads) and as a builder, and when the late Timothy Eaton left $10,000 to be spent by Mr. Campbell on three miles of the Dundas Road in Etobicoke township, it was a merchant prince's tribute to Mr. Campbell, his work and his success.

**Some of our readers are anxious as to the binding of The Canadian Engineer. The new size and binding will work with the old size, and the binder will find no difficulty in making Vol. XVII. as neat as Vol XVI.**

## PRECIPITATION FOR SEPTEMBER.

The precipitation was in excess of normal from Eastern Ontario to the Maritime Provinces, while from the Ottawa Valley and Middle Ontario westward to the Pacific there was a very general deficiency, except in the northern parts of British Columbia near the coast, where the rainfall was heavy. The largest positive departures occurred in New Brunswick, where the amount recorded was double the average, and the largest negative in the Western Provinces where the amounts recorded were in nearly all cases less than one inch, and in some but a small fraction of an inch.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for the month.

Ten inches of snow is calculated as being the equivalent of one inch of rain.

| Station. | Depth in inches. | Departure from the average of twenty years. |
|---|---|---|
| Calgary, Alta. | 0.40 | —0.71 |
| Edmonton, Alta. | 0.10 | —1.38 |
| Swift Current, Sask. | 0.70 | —0.64 |
| Winnipeg, Man. | 0.60 | —0.99 |
| Port Stanley, Ont. | 1.00 | —1.78 |
| Toronto, Ont. | 1.96 | —0.77 |
| Parry Sound, Ont. | 4.90 | +1.09 |
| Ottawa, Ont. | 3.10 | +0.43 |
| Kingston, Ont. | 3.90 | +1.20 |
| Montreal, Que. | 4.90 | +1.64 |
| Quebec, Que. | 6.40 | +2.69 |
| Chatham, N.B. | 8.20 | +5.33 |
| Halifax, N.S. | 5.90 | +2.06 |
| Victoria, B.C. | 0.80 | —1.40 |
| Kamloops, B.C. | 1.20 | +0.21 |

## SOCIETY NOTES.

Mr. W. J. Francis, C.E., of Montreal, addressed the Engineering Society of Toronto University in the Chemical and Mining Bldg., on Wed. afternoon, Oct. 13, his subject being The Relation of Technical Education, Personality and Character, to the Engineer," which was a resume of his own experience in this line. Mr. W. D. Black was chairman. Mr. Francis is a graduate of the School of Practical Science, and has been engaged in government work as consulting engineer for some time. He was called into consultation regarding the danger threatening the Quebec bridge.

After the meeting Mr. Francis was entertained at the St. Charles Cafe by the past presidents of the society. Mr. H. E. T. Haultain, presided.

## AMERICAN INSTITUTE ELECTRICAL ENGINEERS.

The annual meeting of the Toronto Section of the Institute will be held Friday, October 15th, at 8 p.m., in the rooms of the Engineers' Club, 96 King Street West. Mr. A. J. Soper, of Smith, Kerry & Chace, Toronto, will present a paper on "Transmission Line Calculations." The Executive Committee will submit, for final vote, the list of recent nominations for officers for the coming year.

An informal luncheon will be served at the St. Charles Cafe at 6.30 p.m. sharp, to which members are requested to invite their friends.

## 1,200-VOLT D. C. CAR EQUIPMENT.*

By F. E. Case, Engineer of Railway Equipment, General Electric Company.

Direct current of 1,200 volts has been adopted in preference to 600 volts as the trolley potential of a number of interurban and other railways on account of lower first cost and lower cost of operation. That 1,200-volt current can be more economically delivered to the car requires little argument. On a railway having a given size and length of feeder, a car equipped with 1,200-volt apparatus will entail a line loss of only one-quarter that of a 600-volt car of the same size operating at a similar speed. With dense traffic, where cars are required to run on a very close headway, consequently giving practically a uniformly distributed load, the substations at 1,200 volts can be located twice as far apart as at 600 volts for the same maximum per cent. line loss.

Under the other extreme condition of two cars or trains only between substations and passing midway the substations can be located four times as far apart as at 600 volts with the same maximum per cent. line loss. The latter condition, however, is rarely practical for interurban operation on account of the great headway between cars. Under the usual prevailing conditions of interurban service it will be found that the substations at 1,200 volts can be located from 2½ to 3 times the distance apart as at 600 volts to give the same percentage line loss.

The adoption of commutating poles has made the operation of 1,200-volt generators entirely practicable. Where alternating current is better adapted to long-distance distribution, rotary converters in substations are also well designed to translate the alternating current to 1,200 volts direct. No more complicated or less reliable pieces of switchboard apparatus are required in the power house or substation than for the ordinary voltages.

Either the third rail or trolley wire can be used for carrying current to the car. One road is now successfully using the former, and there are several others using the latter. The third rail is of the under-running type, and is installed in a similar manner to a 600-volt practice, but the insulators are of somewhat increased dimensions.

No radical departure from standard 600-volt practice is required in the line construction to ensure a safe insulation. Cross suspension, side bracket or catenary method of trolley wire support can be used, but additional insulation over that used for 600 volts is, of course, required. The catenary form of suspension is usually recommended, as not only does it require a minimum number of poles and insulators, but it provides the most flexible support, which is a great advantage for high-speed operation.

The standard trolley base, pole and wheel give better results than with 600 volts, as the current to be collected for a given weight and speed of car is only half, which increases the life of the wheel especially.

The motors are similar electrically to ordinary 600-volt commutating pole motors, with increased insulation, and there is no departure in mechanical features from other direct current motors for lower voltage. The brush holders are located in a similar manner, and there are no more of them, so that inspection is just as readily made as in other

* Abstract of paper presented on Section (k) of the report of the Committee on Equipment of the American Street and Interurban Railway Engineering Association, Denver, Col., October 4, 5, 6, 7 and 8, 1909.

direct current motors. The commutation of the motors is so good that no more attention to the brushes and commutator is required than with low voltage motors of similar capacity. As the motors have the same electrical characteristics as other direct current motors, the armature speeds are no greater, and in consequence the bearings are equally long lived.

Some motors have been furnished by the General Electric Company for operating directly on 1,200 volts and others two in series. With the former it is possible to operate at only half speed on 600-volt portions of the line, but the latter motors can be connected in multiple so as to give the same speed on the low voltage as the high, which in many cases is a great advantage.

The car equipment consists of apparatus similar to that used for 600 volts, many of the parts being identical. Cylinder platform controllers have not been used in any instance, however, as they require the motor current to be carried above the floor, and we have considered it advisable for obvious reasons to keep the apparatus that breaks the main circuit under the car, where it can be suitably isolated.

Sprague-General Electric Type M control, comprising electrically operated contactors, a reverser and a circuit breaker is used. These parts are practically the same as for 600 volts with additional insulation where required. Both automatic control as described in my paper of last year for 600-volt operation and hand, or non-automatic, control have been furnished. The circuit connections are identical, for both the master control and the motors, to that used for 600 volts.

Standard 600-volt contactors, operated by means of electro-magnets, are employed for making the motor and resistance circuits in the contactor box, a few extra contactors being used to provide the necessary breaks in series to safely open the circuit. Practice has shown that a 1,200-volt current can be very satisfactorily interrupted by the contactors, and that the burning is not excessive.

Proper insulation of the reverser contacts is easily secured, owing to the motor fields being reversed, instead of the armatures when the direction of car movement is to be changed, and also because the fields are connected to the ground side of the armatures. This connection of the motors has been adopted both in new cylinder controllers and type M control for 600 volts. For commutating pole motors, it is desirable, in order that the commutating field winding, which is permanently connected to one side of the armature may always be on the ground side of the armature. The connection has also the advantage that fewer of the contacts have a high potential between them, as the drop across the exciting field to be reversed is only about fifteen volts.

A magnetic blow-out circuit breaker, located under the car, similar to the one generally furnished with type M control, is used for an overload protective device. It is, however, provided with a more powerful magnetic blow-out and has an increased opening and insulation. The circuit breaker is set and tripped from the motorman's cab by means of the ordinary double-movement switch which connects to the proper train wires.

A magnetic blow-out copper ribbon fuse box is provided as an additional protective feature for the main circuit. Standard 600-volt cast-grid rheostats are used for providing the necessary resistance steps in starting the motors. These rheostats are effectually insulated from the angle-iron to which they are attached by means of large collars and tubes surrounding the supporting bolts. A new design of cast-grid rheostat has recently been brought out.

When a car equipped with four motors is required to operate at the same speed on both 600 and 1,200-volt sections, it is necessary to use a commutating switch for changing the connections of the motors. For 1,200-volt operation this switch connects the motors in two groups with the motors in each group in series, each group being handled as a single motor. This commutating switch is arranged for operating either by hand or with air controlled by a valve located near the motorman. An interlock device is provided which prevents operation of the contactors if the motors are not properly connected for 1,200-volt running.

On some roads the operating conditions are such that only on the interurban sections is it desirable to obtain the maximum speed. To meet these requirements the commutating switch is, therefore, not necessary, and having 1,200 volts on the high-speed section and 600 volts on the city division gives relative speeds of about 2 to 1.

Six hundred-volt current is used for operating the control, and also for the car lighting. With the earlier equipments the air compressors are also operated at this voltage This current is obtained from a dynamotor, or motor generator, of waterproof design for mounting under the car.

The new feature of the dynamotor is a series field winding which is connected between the two halves of the armature, and is provided with a tap at its centre. In starting up, line current passes through the first half of armature, series field, and second half of armature to ground, thereby strengthening the normal field, and the machine operates as a compound motor. When current is being taken from the tap in the centre of the series winding for the control of lights, the two halves oppose each other, and there is no effect on the field strength. When the trolley leaves the wire with the dynamotor running, and the controller on, there is an immediate tendency of the dynamotor to deliver current to the motors, due to the momentum of the armature and the shunt field. The series winding now comes into play by demagnetizing, or beating down, the field, since the direction of the current has been reversed in the first half of the series field, and the two parts, therefore, no longer oppose each other. This action prevents an amount of current sufficient to blow the dynamotor fuse being taken by the motors.

The dynamotor is a very simple device, both electrically and mechanically. No mechanical load being driven by the armature, the strains on the bearings are negligible and the parts are long-lived. On recent equipments the dynamotor is started up automatically, when the car runs on to a 1,200-volt section, by means of a selector relay. The light and control circuits are disconnected from both the trolley and dynamotor when the relay is not energized, the proper connections being made to correspond with the voltage applied. To insure correct operation of this relay, a short, grounded section of trolley wire is interposed between the 1,200 and 600-volt portions.

The electric heaters can be operated either from the dynamotor or directly from the 1,200-volt circuit. As the conductors in the heater are insulated from the frame by porcelain, the requisite insulation is easily secured for 1,200-volt operation.

The air compressors on some recent equipments are wound for operating at 1,200 volts, as there is no difficulty in obtaining good commutation and insulation for this voltage. When the car is running on the 600-volt section the compressor will, of course, be required to operate for a longer period if air is used to the same extent as on the 1,200-volt portion, but this is easily taken care of in selecting the proper capacity of compressor.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadiao Engioeer for a small fee.

8177—September 20—Approving rearrangement of the C.P.R. Company's tracks between Bents 2, 3, 4 and 5, and elevation and clearances of the overhead footbridge at Brown Street, West Fort William, Ont.

8178 and 8179—September 25—Granting leave to the Manitoba Telephone System to cross the track of the C.N.R at Glenforsa Siding, Man., and at Third Street, Belmont, Man.

8180—September 25—Authorizing the C.P.R. to construct industrial spur for the Speitz Fur. Company and for the Hanover Cement Company at Hanover, Ont.

8181—September 25—Authorizing the G.T.R. to construct branch line and three spurs therefrom to the premises of Asbestos Manufacturing Company, Lachine, P.Q.

8182—September 25—Authorizing the C.P.R. Company to construct branch line for the Sydney Brick Company, Sydney, Man.

8183 — September 25 — Authorizing the C.P.R. to construct branch line in the City of Calgary, Alta.

8184—September 25—Approving Supp. 2 to Canadian Freight Classification No. 14.

8185 — September 25 — Authorizing the C.P.R. to construct trestle bridge at mileage 63.5 on the Moose Jaw branch of its line.

8186—September 25—Authorizing the G.T.R. to construct branch line of railway for Sanderson-Harold Company, Paris Junction Station, Ont.

8187—September 25 — Authorizing the G.T.R. to construct branch line of railway for the Bechtells, Ltd., Waterloo County, Ont.

8188—September 25 — Authorizing the C.P.R. to construct spur for Messrs. Carbonneau, Leroux & Forget, Parish St. Vincent de Paul, P.Q.

8189 — September 25 — Authorizing the C.P.R. to construct branch line to the Asquith Ballast Pit on the Pheasant Hills branch of its railway, Province of Saskatchewan.

8190—September 25—Granting leave to the G.T.P. to operate its trains across Pembina branch C.P.R. at Oak Point Junction, near Winnipeg, Man.

8191—September 25 — Authorizing the C.P.R. to construct branch line in the Parish of Lachine and town of Lachine, P.Q.

8192—September 29—Granting leave to the C.N.Q. to place its wires and tracks under the wires of the Bell Telephone Company at Charlesbourg Road, County of Quebec, P.Q.

8193 to 8195—September 25—Granting leave to the Hydro-Electric Power Commission to place and maintain its transmission wires across the track of the G.T.R. at three points in the Province of Ontario, viz., Township of Glanford, County Wentworth; Village of Allenburg; and Township of Thorold, County of Welland, Ont.

8196—September 27—Authorizing the C.P.R. to open for the carriage of traffic that portion of the double track of its line of railway, known as the Kenora Section, from Busteed, mileage 16.0 to Deception, mileage 18.8.

8197—September 23—Approving and sanctioning location of the C.N.Q. Railway Company's line of railway from Hedleyville Junction to a point on the Montmorency River, County and Province of Quebec, mile 0 to 7.62.

8198—September 27—Authorizing the G.T.P. to operate its trains over crossing of the Pembina highway, Winnipeg, Man., without being brought to a stop.

8199—September 27—Authorizing the Brantford Gas Company to lay gas main under the track of the G.T.R., where the same crosses Colborne Street, Brantford, Ont.

8200—September 27—Granting leave to the Rural Municipality of Macdonald, Man., to place its wires across the track of the C.N.R. at P.C. 960 ft. south-west of Brunkild Station, Man.

8201—September 28—Granting leave to the Le Chemin de Fer de Colonization de Nord to construct its railway across certain highways between mileage 10 north-west from Nomining, and Rapide de l'Orignal County, Labelle, P.Q.

8202 to 8204—September 25—Granting leave to the Hydro-Electric Power Commission of Ontario, to cross with its transmission wires the track of the G.T.R. at three points in Ontario, viz., Township of West Flamboro, Lot 23, Con. 1; Township of West Flamboro, Lot 19, Con. 1, and Township of Nelson, County Halton, Ont.

8205—September 28—Authorizing the C.P.R. to construct branch line across several streets in the City of Regina, Sask.

8206—September 28—Authorizing the C.N.Q. to reconstruct the western trestle approach of its bridge over Ottawa River, near Hawkesbury, Ont.

8207—September 27—Dismissing application of the Canadian Freight Association, for an Order rescinding Order of the Board (Sec. B) dated October 10th, 1904, fixing rates on fruit, in C.L. from Eastern Canada to Winnipeg, Portage la Prairie, and Brandon, Man.

8208—September 14—Approving and sanctioning plan, profile, and book of reference of the Montreal Park & Island Railway and authorizing the deviation of its line of railway from a point in Lot 142 of Parish of Montreal to a point near Lot No. 1698, Parish Montreal, P.Q.

8209—September 28—Granting leave to the Saskatchewan Government to place its wires across the track of the G.T.P between Sections 32 and 33, Township 35, R. 4, west 3rd Mer., Province of Saskatchewan.

8210 and 8211—September 28—Granting leave to the Bell Telephone Company to cross with its wires the track of the C.N.Q. at St. Canute, P.Q., and ½ mile north of Duncan Station, Ont.

8212—September 28—Authorizing the Municipal Council of City of Medicine Hat, Alta., to lay water mains under track of the C.P.R. at River Street and at East Road Allowance, in said city.

8213—September 28—Authorizing the Sarnia Gas & Electric Light Company, Ltd., to lay and maintain its gas mains under the track of the G.T.R. where the same crosses South Christina Street, Sarnia, Ont.

8214 — September 28 — Authorizing the C.P.R. to construct branch line for the Joliette Sand & Gravel Company in Parish of St. Felix de Valois, Con. of St. Martin, P.Q.

8215—September 29—Authorizing the Vestry of St. James Church, Bethier, P.Q., to lay an eight-inch sewer under the track of the C.P.R., fifteen feet from the north side of Williams Street, Village of Berthier, P.Q.

8216—September 29—Granting leave to the Mt. McKay & Kakabeka Falls Railway to cross with its track the track of the C.N.R. at Montreal Street, Fort William, Ont.

8217—September 30—Approving and sanctioning revised location of the C.P.R. from McKay Avenue to Victoria Avenue, Edmonton, Alta.

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Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

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Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

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THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## A GERMAN INSPECTION OF BRITISH SEWAGE DISPOSAL WORKS.

Dr. A. Schiele, of the Royal Testing Station for Water Supply and Sewage Disposal, Berlin, has recently issued a report of a monumental character, consisting of about 870 pages of text, fully describing and studying British sewage disposal works from the German standpoint. The conclusions and criticisms set forth are of considerable value to all interested in this matter.

Special attention is drawn to the fact that the experience gained in England demonstrates that the biological system of sewage purification has been found to stand the test of time so long as the works are properly designed and carefully managed, and the German authorities are strongly urged to study English methods on the spot by actual inspection. In Germany, as elsewhere, there still exist sceptics who are not prepared to accept the statement that the biological system can be universally applied with success, and this is due to the fact that they are in a position to refer to several failures in their own country. Dr. Schiele points out that these failures are not the result of any defects of the system itself, but are due partly to bad design, and, in far the greater number of cases to ignorance and inexperience, and above all to neglect in management.

The author insists upon the absolute necessity of employing experienced practical experts to supervise and design all works, and where towns are too small to employ an expert, they should combine to obtain the services of one man. The doctor also points out in the second instance the advisability of the establishment of a regular system of rivers inspection by men (with independent and unbiased judgment) who are capable of carrying out continuous tests and observations of the results obtained from the various purification works.

We publish in this issue a paper read before the American Society of Inspectors of Plumbing and Sanitary Engineers, entitled "The Cesspool and its Dangers," by Burton J. Ashley, C.E., Chicago, Ill.

This paper is brimful of real commonsense, and is one which should not only appeal to the engineer or architect, but could most usefully be read by the suburban householder and town councillor responsible for the management of our smaller towns, where the cesspool is the favorite method adopted for sewage disposal

In Canada we have scores of towns and villages, whose water supply is dependent upon shallow wells, sunk a few feet into water-bearing sand or gravel. Alongside such wells we find the cesspool doing duty. In many cases this structure consists merely of a pit or loosely-built tank, which allows the liquid sewage to percolate into the water-bearing sand or gravel.

It is only a matter of time before typhoid makes its appearance under the above conditions; and, unfortunately, it is as a rule only upon an outbreak of this dreaded disease, that reasonable attention is directed to a method of obtaining domestic water supply from a source which is made the disposal area for the town's sewage.

## THE CESSPOOL AND ITS DANGERS.*

By Burton J. Ashley, C.E., Chicago, Ill.

During last year I received a letter from a prominent clubman of the Northwest, who wrote: "Our cesspools (three largest built locally) won't 'cess,' and have been useless and impossible for the past four years," to which we made the reply that the greatest trouble people find with cesspools, in our experience, is that they do "cess." A cesspool, derived from the word "cease," is a "cease" pool—that is, it is a quitter; it ceases and won't do anything. It may, and does, put forth a strangled effort, but nature's forces become so stultified in these ill-designed contrivances that the active natural agents of purification are completely smothered and die, and thereby the ceasing and consequent danger.

You may as well expect the average cesspool to be successful in disposing of your sewage as to expect a fire to burn in the bottom of a hole in the ground with the top of the hole covered.

The Saturday Evening Post recently gave the Merchants' Association Committee on Pollution of the State Waters of New York permission to reprint some articles for general distribution regarding the cause and spread of typhoid fever, and contained in them may be found the following:

"Great cities are developing some sort of a sanitary conscience. Farmers and country districts have as yet little or none. Bad as our city water often is, and defective as our systems of sewage, they cannot for a moment compare in deadliness with that most unheavenly pair of twins, the shallow well and the vault privy. A more ingenious combination for the dissemination of typhoid than this precious couple could hardly have been devised. The innocent householder sallies forth, and at an appropriate distance from his cot he digs two holes, one about thirty feet deep, the other about four. Into the shallower one he throws his excreta, while upon the surface of the ground he flings abroad his household waste from the back stoop. The gentle rain from heaven washes these various products down into the soil and percolates gradually into the deeper hole. When the interesting solution has accumulated to a sufficient depth, it is drawn up by the old oaken bucket or modern pump, and drunk. Is it any wonder that in this progressive and highly civil-

*A paper before the American Society of Inspectors of Plumbing and Sanitary Engineers.

ized country three hundred and fifty thousand cases of typhoid occur every year with a death penalty of 10 per cent.?"

Let me cite you an instance to illustrate to you the possibilities of water pollution through underground veins or crevices and its lamentable results. The case is an old one to sanitarians, but new, no doubt, to some. A small village in Switzerland; near Basle, is supplied with water from a spring situated at the foot of a mountainous ridge. An epidemic of typhoid fever broke out, which struck down over 17 per cent. of the panic-stricken inhabitants of the village. The fever was pretty well distributed through the village, but a group of six families had entirely escaped the scourge. Suspicions were aroused regarding the purity of the waters of this spring, and an investigation was made.

On the other side of the ridge before alluded to was a little valley, which when irrigated, always increased the flow of the spring on the other side of the mountain. It was found that a peasant, living in the valley, had returned from a distant city, sick with a fever, and that the water in a little brook in which his clothes had been washed and into which the slops of the house had been cast had been used to irrigate the meadows. Of course, the polluted water filtered through the surface of the soil and joined the underground water, to go—no one knew where.

In order to determine if it could be possible this spring was fed by the underground waters of the valley over a mile away, experiments were made. A large quantity of salt was thrown into a hole dug in the valley to a water-bearing vein of sand and gravel. In a few hours the waters of the spring became very salty.

They now mixed two and one-half tons of flour with water and poured this mixture into the hole, but after much waiting and close examination not a trace of the flour could be found in the water in the spring.

This proved conclusively that, though the water-bearing vein through which this water had to pass carried salt in solution to the spring, at the same time the granular constitution of the vein was sufficiently fine to prevent the finest particles of flour reaching it.

It should, then, be quite clear to the reader that the passage of water through underground veins is no assurance of its purity, and neither is clearness any proof of purity—for, says Mason: "It is a fatal error to fancy that because a water has a bright, sparkling, clear appearance and a pleasant taste, that therefore such water is wholesome. Carbonic acid gas is what causes brilliancy and refreshing taste of a ground water. When it is borne in mind that carbonic acid is one of the products of sewage decomposition, the inference as to its possible source is not a pleasant one." Neither is turbid water to be adjudged as dangerous merely because it is turbid. While visiting, a few years ago, the city of Defiance, Ohio, which then derived its water supply from the Auglaize river, and on drawing a glass of water from a faucet in the hotel, I was obliged to wait until the heavier suspended particles could settle to the bottom of the glass before it was sufficiently wholesome to drink. The water was roilly and unsightly as well as unwholesome, but was not regarded as unsafe at that season of the year, when the Auglaize river was nearly overflowing her banks in consequence of the prevailing rains.

"I recently asked a wealthy maunfacturer how he disposed of the sewage of his summer home at one of the lakes in Northern Michigan. "Oh," said he, "I dig a cesspool down to the gravel, and then the stuff runs away." "Where is your well?" said I. "About one hundred feet away," was the answer, and then he proceeded to explain to me, in an assuring way, that the bowel discharges and sink wastes that went into his cesspool would be entirely purified by passing through the strata of fine gravel before reaching the well. Now, this man I know to be a gentleman of splendid intelligence, the mayor of a city and a leading light in his community, but, in spite of his intelligence, he was totally ignorant of what the essential processes are that produce sewage purification. He evidently had in mind that the substrata of gravel would filter the cesspool seepage to purity. He did not know that purification of such foul liquid is impossible without fresh air and the action of aerobes. And here lies the danger: that the common people, and even the most intelligent people, are led astray sometimes through lines of their own incorrect reasoning, and sometimes through erroneous information imparted by pretenders that know nothing of the principles of decay, but try to make folks think they do.

The opportunity for the contamination of well water, particularly in towns and villages or in the suburbs of towns and cities where sewerage is absent, is often very great. It is no uncommon practice for the owner of a small lot to construct his well and a cessool within a few feet of each other. The contents of this filth hole soak away and mingle with the ground waters, only to reach the well; for even the most ordinary mind can see that as water in drawn from a well the well is replenished by just so much of the ground water surrounding it, and if this ground water is polluted, health and life of your family or neighbors are jeopardized.

The question then might arise as to the advisability of using a cesspool where city water mains were available, but we answer that if we live up to the standard of righteousness and of model citizenship, then it would be an example of the grossest selfishness on one's part not to have an interest in the welfare and health of one's neighbors who might yet be using wells, for through such selfish indifference to the health and welfare of the neighbourhood we might be rightfully regarded as undesirable citizens.

Mason also says that "It is hopeless to depend upon the purifying influence of the intervening soil to protect the wells from privy and cesspool fouling, because soil filtration, in order to be effective, must be intermittent." With a constant flow of pollution on or through any soils, the purifying powers of the soil quickly cease to act. Intermittent flow is absolutely essential to admit air to the aerobic bacteria where present, if purification is to be effected.

E. Bailey-Denton, in one of his courses of lectures delivered to the students of the Royal Agricultural College, England, said of the cesspool as a method of sewage disposal: "It is a system of disposal which I do not recommend, and which should always be avoided if possible, and no matter if built under circumstances most favorable, will remain liable to all the objections to which cesspools are admittedly subject."

Rideal, the well-known English authority on sanitation, has pretty well described the results of harboring a cesspool. He says, and it is reasonable to believe, that "the soil about cesspools becomes water-logged with black fœtid matter which undergoes little or no oxidation." I here wish to add that without oxidation of the seepage of cesspools, say nothing of the liquids of the septic tank, purification of sewage is not accomplished.

Dr. Bashore, former inspector for the Pennsylvania State Board of Health, in his little work on the "Sanitation of a Country House," says of the cesspool: "It is a relic of medieval shiftlessness and carelessness for which no excuse can be offered."

Prof. Merriman, in his "Elements of Sanitary Engineering," says: "The privy or cesspool is walled up with loose

stone so that the liquid material may leak through them into the surrounding soil. The result of this is a gradually increasing pollution of the soil, and often a neighboring spring or well becomes contaminated so as to cause disease." He then cites an instance where a spring had been previously condemned by the board of health, but in spite of the warning the people of the neighbourhood continued to drink its water, with the result that twelve cases of typhoid fever occurred, and two deaths. Such an example of repugnant stupidity can scarcely be paralleled. Truly may we say: "What fools we mortals be." Thousands of such cases are recorded in medical journals that never reach the notice of the great groping public.

Dr. Frank E. Adams, of Piqua, Ohio, has the following to say in the "Ohio Sanitary Bulletin": "In our own city we have found traces of discoloration, when excavating for cellars, that were traced to old cesspools one hundred feet away, and no telling how far beyond the excavation the discoloration extended.

"The city engineer tells me that when excavating for a sewer they passed through a discoloration in the soil that extended forty feet in width, the odor arising from it almost compelling the laborers to cease working. He said they were about nine feet deep, and had passed through one foot of this stuff; how much deeper it extended he did not know, as they were then at the sewer bottom, nor the length of it, but that there was no cesspool nearer than forty feet."

Mr. Thomas S. Ainge, sanitary engineer for the Michigan State Board of Health, and a member of this society, in his recent work on the "Sanitary Sewage of Buildings," says that smaller cities and villages resorting to cesspools endanger the water in private wells and create an unwholesome condition of the subsoil in the immediat vicinity, and that such a practice is inexcusable, yet often permitted for years. That boards of health, even to the present day, have a misunderstanding of the relative inefficiency and dangers created by the use of leaching cesspools.

While in Madison, S. Dakota, last summer, a remarkable instance of the dangerous availability of a cesspool as a death trap was related to me. The filth hole in question was some four or five feet in diameter, and about ten or fifteen feet deep, reaching a gravel bed, which was supposed to absorb the filth, but did not, and this death trap, was full of unfermented human excrement and other foul matters, covered with boards and earth. As a child of the proprietor was passing above and upon the top of it, the top gave way and the child sank into the filth up to her arms. Screaming and sinking, she was only rescued in just time to save her life, and just as her head and chin were reaching the surface of the corruption. We leave you the mental picture to contemplate.

Many cesspools are similarly covered with boards and earth, on which the grass soon grows, and the location is forgotten. It does not take a very great stretch of imagination to realize the direful result which might be caused by such improper construction, which could be directly contributory to the loss of life by accident.

A letter was recently submitted to the writer by a well-known publication on sanitation, which, in part, read as follows:

"Will you let me know what is the best way in which to drain the surplus water from a cesspool. As matters now stand, we are compelled to haul this waste out of town, at an expense of about $15 per month."

A part of our reply was as follows:

"If your cesspool is costing you $15 per month to maintain, then the yearly cost would be $180, which is 6 per cent. on a capital of $3,000. An individual sewage disposal plant should certainly cost you much less than $3,000, in fact, the average price of plants for ordinary dwellings will only range from $200 to $500." I offer this illustration to show the maintenance of a cesspool from the financial viewpoint.

Some two or three years ago I received a letter from an eminent educator and president of a state institution and the following is an extract from the letter:

"We have dug perhaps a dozen cesspools in the past ten years. As soon as one filled up we dug another, until our grounds (college campus) nearly are full of holes."

This institution has since abandoned the cesspool practice, and has installed a modern sewage disposal plant, and a letter dated December 18, 1908, from the superintendent, says:

"Inlet end of reduction tank, no odor whatever; sludge 8 inches deep; mat 10 to 12 inches thick and very tough; sludge slaty gray color. On opening outlet cover found slight odor, but not offensive, and slight scum, but water is perfectly clear."

Regarding this plant I will say that, after purifying this tank liquid by nitrification, the filtrate or water is disposed of by ground absorption wholly, and within the confines of the college campus.

Since the advocates of advanced hygiene have investigated, experimented with and employed modern rational means of self-preservation, and as one of the advanced means people have their surroundings properly sanitated, the death rate in the United States has been decreasing, until now the average human life has gone beyod the proverbial "three score years and ten." Some have erroneously believed that the hardy pioneers of our land were longer lived than we, but statistics do not prove it. As people employ means to better care for the body, just so is life lengthened.

Typhoid fever decreases in proportion to the increased installation of means of sanitary sewage disposal, and in cities it is in proportion to the increased abandonment of wells as a source of supply of drinking water.

Lawrence, Mass., typhoid death rate in 1890, per 100,000, was above 120, but after employing modern sanitary measures in sewage disposal and water supply, in seven years the typhoid death rate fell to but 16, a falling off at the rate of 104 deaths per year. The contemplation of the satisfactory effects of employing accepted sanitary expedients is rapidly arousing intelligent communities to the necessity of cleanness of person, and the sanitation of surroundings. Hence the introduction of modern devices for cleanliness, such as baths, lavatories and laundries in the modern home, with a rational, safe, sanitary and satisfying means of purifying the poisonous wastes of living and properly disposing of them, is on a speedy increase. The sanitary conscience is arousing everywhere.

A word to the summer hotel or resort keepers, and to the summer visitors themselves. I wish to call your attention to the following Health Bulletin which was recently issued in Chicago, and from which the following is an extract:

"These seekers after rest and happiness are liable to drink polluted surface water in lakes and streams. Open wells are often infected with typhoid fever germs, and are among other sources of typhoid fever. Each year in August there is in this city an increase in typhoid cases, and the investigations show that about one-fourth of all our city cases are contracted in the country, where the victim has been passing his vacation. Typhoid fever is a preventable disease."

From my own experience, and from information acquired from others, it is discovered that the average outhouse con-

veniences at these country resorts are vile and unrespectable, and are maintained by people who would be highly offended if one should assail their respectability, but I say that he who is the maintainer of one of these unspeakable privies and makes no attempt to abolish the nuisance, but continues to foster the nauseating pest spot and offers it to the use of others can not lay claim of decency.

To the summer visitor I would say there is something of more vital importance to you when enjoying your summer outing than front verandahs with easy chairs or beautiful shade and restful hammocks. Don't patronize the place that does not provide for the safety of your health, as well as for the conscious comforts of your mind and body. Modern methods of sanitation are available, and the average farmer or summer hotel keeper is abundantly able to possess himself of sanitary conveniences which advanced habits of living demand.

A word regarding the prevalence of flies. The prevalence of flies in either city or country very closely approximates the prevalence or approximate presence of manure piles, where most of the flies are atchhed. Available privy vaults or cesspools afford them sporting and feeding grounds some of the time, but the dinner table is a popular resort for them when not at the places above mentioned.

D. D. Jackson's report to the Waters Pollution Committee of New York called that body's attention to the presence of vast numbers of disease germs on the feet and legs of flies which had been caught in fly traps for the purpose of microscopical examination, and makes the statement that "the common fly is one of the most active agents in dissemmating certain intestinal diseases."

"There are certain laws of consciousness," says Dr. Sedgwick, "that have for their object the preservation of human life to its appointed maturity, as, for instance, to grasp at a support to prevent a threatened fall. This same consciousness universally arouses an instinctive repugnance toward human excrement or any putrefying animal substance, and instantly warns one through this instructive intellectuality that these repugnant ingredients are baneful to life." No person with ordinary intelligence, after having reflectively contemplated the matter of sewage disposal by building a cesspool, ever dug such a cesspool and used it with a satisfying consciousness that the contrivance would be successful, safe and comforting, but he, on the contrary, must have been conscious that he had not satisfied himself in creating this pest spot. A cesspool is a thing that is untrustworthy, disquieting, noxious, harmful, corrupting and dangerous.

"Back to Nature!" is the present cry of city dwellers, and the city dweller who can afford a country home, even though inexpensive, is moving or laboring to the end of moving to the suburbs or to the country and its loveliness and quiet, and the number is legion. Many thousands of New Yorkers now have their country homes in suburban localities. Thousands upon thousands more spend the greater part of the warm season in country homes in the Berkshire Hills, the Adirondacks or the White Mountains, and yet thousands of others, from all the principal cities of the east and south and great middle west are joining in this one grand, determined, happy exodus back to the country that God made, and away from the cities which man made; but though back to the country, some of the conveniences of city life are too comforting to be left behind. To resort to Mosaic sanitation (Deuteronomy 13: 23) or to dig cesspools as the Indians do, is quite out of keeping with the character of sanitary conveniences some of these would-be country dwellers are used to, and so they are sufficiently wise to employ modern sanitation in these country homes, that there also they may have the modern comforts common to the better grade of city dwellers. To the discerning the cesspool is tabu.

We have read somewhere about a "septic cesspool." One of the words, "septic," signifies action, and the other word, "cesspool," from the nature of its derivation, stands for inaction. The logical definition of these two words conjointly used, therefore, would be "active inaction." The absurdity of such a claim is apparent.

I recently read a short article by some writer, who did not sign his name, that the secret of the septic tank was nothing more than that it must be air tight and have a submerged inlet and a submerged outlet, "and that is all there is to it." Just how can this information be harmonized with the fact that for the last ten years or more scores of septic tanks have been built without any cover whatever, and that chemical analysis has shown that the effluent from the open tank is as satisfactory, as that from the closed air-tight tank?

I also saw a published statement that tanks for residences would rarely need to be larger than to hold 24 to 36 hours' flow, and that a tank 3 feet wide by 6 feet deep and 8 or 10 feet long would ordinarily be large enough. I have computed and find such a tank to contain 1,300 gallons, which clearly shows the most lamentable ignorance on the part of the writer of the amount of sewage ordinarily produced by private residences.

Great care should be exercised in giving out such flat statements as these, for those who are not posted on the subject would surely be led seriously away from the truth, and would more than likely construct something that would be a flat failure.

One has to select a sewage disposal plant for his home in just the same way he would buy a heating plant. Proper capacity is one of the fundamental elements to successful operation. A party in Ohio once wrote me that if he could not get a sewage disposal plant for his home that would take care of the sewage of fifteen persons as readily as for two he did not want anything to do with it. I replied, asking him if he would expect a stove that was gauged to burn satisfactorily two scuttles full of coal per day to burn fifteen scuttles of coal with the same satisfactory results. This comparison should be convincing, for sewage disposal plant and stoves are strikingly analogous in their operation.

The laity has been wrongly led to believe that the septic tank purifies sewage. This is positively untrue. The septic tank, settling or reduction tanks, are only a primary means to the end of purifying sewage, the real purfication being effected by nitrification or oxidation, which process is accomplished only by bringing sewage or tank liquids into contact with surfaces covered with the aerobic film, and in which the aerobes are kept in active condition by intermittent application of organic wastes and with air.

There are occasional examples where cesspools seem to answer the requirements merely of disposal, but exceptions cannot be held up as an example to follow. Moreover, when a cesspool is able to liquefy the solids that enter it, then it is no longer a cesspool, but a septic tank or hydrolitic tank. But liquefaction in a septic tank is not purification, and moreover, when sewage disposal becomes oversepticized, purification will not take place. It is entirely possible to convert and purify sewage without the tank processes whatever, employing nitrifying bacteria to do all the work. By this means putrefaction does not take place, nor is any fermentative odor produced, for there is no fermentation.

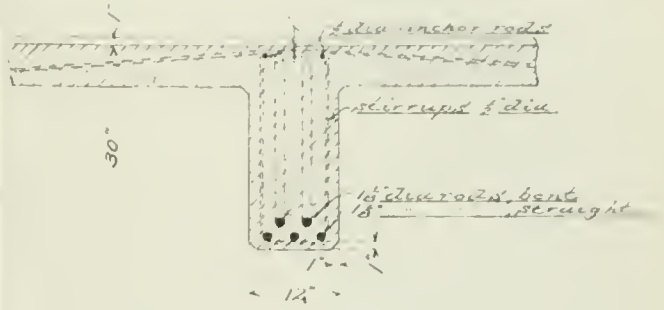
A prominent physician of one of the Southern States remarked in a recent letter, written me, that he did not see the difference between turning sewage loose in the soil and

nitrification. I answer that turning it loose into and four feet deep, say, beneath the surface of the soil would be a mighty difference, since nitrifying bacteria do not exist in sufficient numbers at such a depth to be satisfactorily effective. The depth beneath the surface of the ground where unconverted sewage may be applied has everything to do with the degree of nitrification that can be accomplished. Applying organic substance to the very surface of the soil for nitrification can hardly be improved upon by artificial expedients.

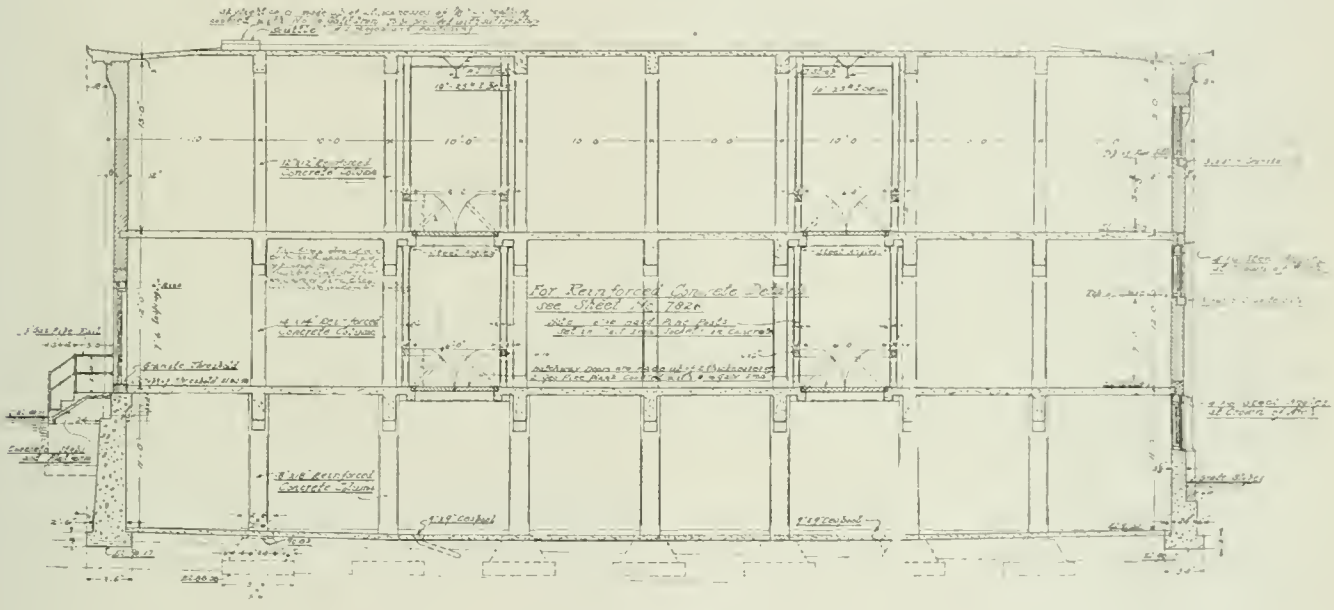
The filter bed, the underground nitrification duct or nitrification bed has, therefore, the object of producing the same final processes of purification as are so readily produced at the surface of the soil, and where quantities of sewage are not too large and the character and condition of the soil, water supply and a number of other essential items are fully understood, plants may be so designed for such known conditions as to successfully purify the sewage and then admit of the absorption of the filtrate or water into the soil. By this rational modern sanitary expedient the dweller is safe from the sorrow and desolation that may be caused by harboring that which sanitarians universally condemn—the cesspool.

## COMPOSITE BRICK AND BUILDING CONSTRUCTION.

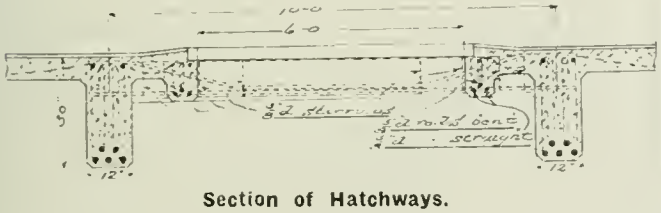
One obstacle in the way of securing cheapness in constructing reinforced concrete buildings is the cost of the forms which frequently cannot be used again. Mr. F. W. Dean, mill engineer and architect, of Boston, has recently designed a number of buildings with brick walls and reinforced concrete floors and roofs, which remove this obstacle and overcome the objections frequently urged against the appearance of reinforced concrete buildings. One building 48 ft. deep, 4 inches wide by 82 ft. long in outside measurement is two storeys in height with basement. The foundation are of concrete carried well below grade, the walls above are of brick 12 inches thick between pilasters of 20 inches thickness. Floors and roof are of concrete reinforced by galvanized wire cloth. The first and second floors, 6½ inches thick including "monolithic finish" are supported by integral reinforced concrete beams running crosswise of the building. These beams, 30 inches in depth by 12 inches in thickness, rest at their ends on the brick wall pilasters and at the middle are supported by reinforced concrete columns. They extend 10 inches into the pilasters and are bonded thereto by one inch parallel steel rods embedded in the walls.



Section of Floor Girder.



Longitudinal Section.



Section of Hatchways.

These rods, two at each end of the beam, pierce its ends at right angles. To make the bond still more secure the longitudinal top and bottom reinforcing rods are turned at their ends. On the sides of the building the floors butt against the brick walls, the granolithic finish filling in or smoothing over any space between the two. But at the ends these floors and the integral longitudinal hatch beams extend into and rest on the brick walls. The roof, 4 inches thick, is also reinforced with wire cloth, and bonded to the walls upon which it rests. The cornice, properly reinforced, overhangs 18 inches beyond the face of the pilasters.

The accompanying illustrations show the method of construction employed by Mr. Dean. The concrete girders and floor beams are connected to the brick work without difficulty.

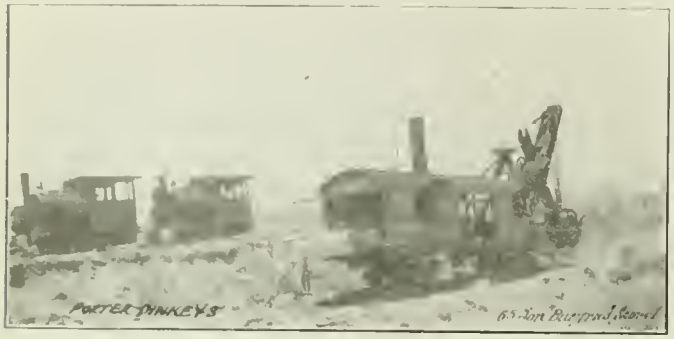
# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### COST OF EXCAVATING GRAVEL WITH A 65-TON STEAM SHOVEL IN A CANAL PRISM.

J. B. Brophy.*

This work was done in June 1908, in the heavy cutting south of the Grand Trunk Railway, near Trenton, Ontario—this cutting being a portion of Section No. 1 Ontario-Rice Lake Division of the Trent Canal. The material excavated




was a coarse gravel mixed with medium sized boulders, and the cutting, at that stage of the work, was a side cutting averaging about 10½ feet in depth. The material was loaded into cars as high as the crane would reach.

From June 1st to 13th the amount of excavation was 10,000 cubic yards, the average haul being 1,200 feet, and from June 15th to 30th 20,000 cubic yards were excavated, the haul averaging 1,400 feet, making a total of 36,000 cubic yards of excavation for the month, with an average haul of 1,311 feet. All the material excavated was put in a spoil bank, averaging from 10 to 18 feet deep.

The following is a list of the plant used on this work: A 65-ton steam shovel with a 2½ cubic yard dipper, made by the Bucyrus Steam Shovel Company, of South Milwaukee, Wisconsin. Two 12-ton Porter Dinkey Engines, 22 dump cars of four cubic yards capacity, and about half mile of track.

The value of this plant would be approximately as follows:—

| | |
|---|---|
| 65-ton shovel | $ 8,500 |
| 2 twelve-ton dinkey's | 5,400 |
| 22 four yard dump cars at $220 | 4,480 |
| 17 tons rails at $30 | 510 |
| 1,100 ties at $0.10 | 110 |
| Shovels, bars, etc., say | 40 |
| Total | $19,400 |

Allowing 2 per cent. for monthly interest, repairs and depreciation, gives a monthly charge of $388.

The shovel, hauling and dump gangs worked twelve hours per day. The track gang and water wagon only worked ten hours per day.

Assuming the standard rates of wages for this class of work, we get the following:—

| | | |
|---|---|---|
| Shovel runner | $125.00 | per Mo. for 10 hour day |
| Craneman | 90.00 | " " " |
| Fireman | 60.00 | " " " |
| Watchman | 45.00 | " |
| Dinkey runners | 3.00 | per day of 10 hours |
| Brakemen | 1.75 | " " " |
| Foremen | 3.50 | " " " |
| Pitmen | 1.75 | " " " |
| Oiler | 1.75 | " " " |
| Laborers | 1.50 | " " " |
| Water boy | 1.00 | " " " |
| Teams | 5.00 | 2 2 " " |

As 26 days were worked during the month, the cost of the work and the organization of the forces, would therefore be:—

Loading—

| | | |
|---|---|---|
| 1 Shovel runner | $150.00 | |
| 1 Craneman | 108.00 | |
| 1 Fireman | 72.00 | |
| 4 Pitmen | 218.00 | |
| 1 Team hauling water | 130.00 | |
| 52 Tons coal at $5 | 260.00 | |
| Oil, waste, etc., say | 10.00 | |
| | | $ 948.00 |

Hauling—

| | | |
|---|---|---|
| 2 Dinkey runners | $187.00 | |
| 2 Brakemen | 109.00 | |
| 1 Oiler | 45.50 | |
| 1 Trackman | 45.50 | |
| 48 Tons coal at $5 | 240.00 | |
| Oil, waste, etc., say | 14.00 | |
| | | $ 641.00 |

Dumping—

| | | |
|---|---|---|
| 1 Foreman | $100.20 | |
| 16 Laborers | 748.80 | |
| 1 Water boy | 31.00 | |
| | | 889.00 |

Track Gang—

| | | |
|---|---|---|
| 1 Foreman | $ 78.00 | |
| 5 Laborers | 195.00 | |
| | | $ 273.00 |

Miscellaneous—

| | | |
|---|---|---|
| 1 Superintendent | $150.00 | |
| Proportion of timekeeper's wages | 30.00 | |
| 1 Watchman | 45.00 | |
| | | $ 225.00 |
| Interest, repairs and depreciation, estimated | | 388.00 |
| Grand total | | $3,364.00 |

* Division Engineer, Ontario—Rice Lake Division of the Trent Valley Canal.

The cost per cubic yard of material excavated would therefore be:—

| | |
|---|---|
| For Loading | $.20 |
| " Hauling | .18 |
| " Dumping | .24 |
| " Track gang | .08 |
| " Miscellaneous | .06 |
| " Interest, repairs, and depreciation, estimated | .11 |
| Total | $.93 per cub. yd. |

Under the circumstances, the quantity of material moved is very large for this size of shovel, being at the rate of 1,385 cubic yards per 12 hour shift, or something over 115 cubic yards per working hour, and when it is considered that only 4-yd. cars were being loaded, and the average depth of cutting was only 10½ feet, it will be seen that the record is a very good one.

The contractors on this work are Messrs. Larkin & Sangster, of St. Catharines, Ont., Mr. Wallace was the superintendent in charge for the contractors, and Mr. E. G. Cameron is the assistant engineer in charge of this section

## ASPHALT PAVEMENTS.

During 1908 the city of Hamilton laid by day labor five stretches of asphalt pavement, and through the kindness of the city engineer we are able to give the detail of costs and figures reduced to prices per square yard

| | | | | | |
|---|---|---|---|---|---|
| **Labour:—** | $ | $ * | $ * | $ | $ |
| On gutters and foundation | 303.60 | 262.10 | | | |
| Grading | 158.54 | 105.65 | 157.27 | 785.75 | [illegible].14 |
| Road rolling | 23.50 | 13.00 | 37.20 | 104.7 | 121.4[illegible] |
| Chanigng gutters | 29.88 | | 22.00 | 31.5[illegible] | 14.[illegible] |
| At asphalt plant | 227.51 | 226.85 | | 122.94 | |
| Laying asphalt | 329.54 | 317.20 | 118.16 | 583.13 | 146.46 |
| | | | 157.89 | 786.18 | 264.2[illegible] |
| **Materials:—** | | | | | |
| For Foundation and Gutters.— | $ | $ | | | |
| Stone, loads | 28— 38.70 | | $ | $ | $ |
| Gravel, loads | 70—105.40 | | 12— 12.00 | | 8.[illegible] |
| Cement, bags | 740—340.40 | | | 80—129.20 | |
| Stores | 3.91 | 4.26 | | 437—201.02 | |
| Extras | | | | | 12.93 |
| Brick | | | | 170.32 | |
| | | | | 5,200—139.62 | |
| At Asphalt Plant— | | | | | |
| | $ | $ | | | |
| California asphalt | 43,745—546.81 | 51,954—649.42 | $ | $ | $ |
| Cuban asphalt | 12,023—180.34 | 13,875—208.12 | 27,819—347.74 | 136,356—704.44 | 47,1[illegible]—588.82 |
| Stone, cu. yd. | 51— 58.82 | 107—123.05 | 6,241— 93.61 | 27,786—416.79 | 13,314—199.71 |
| Oil, gallons | 802— 83.18 | 483— 44.66 | | 261—309.48 | 35— 40.25 |
| Pitch, pounds | 2,340— 24.30 | | 268— 24.78 | 1,803—167.39 | 582— 54.38 |
| Sand, loads | 58— 96.52 | 169—279.67 | | | |
| Cement, lbs. | 1,980— 9.90 | 7,400— 37.00 | 32— 53.62 | 183—316.38 | 50— 81.67 |
| Stone dust, lbs. | 17,310— 73.08 | | 5,082— 25.41 | 16,640— 83.20 | 4,185— 20.94 |
| Wood, coal, stores | 11.50 | 11.40 | | | |
| Extras | | 74.45 | 25.84 | | 18.[illegible] |
| Removing old timber | 12.27 | | 14.38 | | |
| | $ | $ | | | |
| Total | 2,657.70 | 2,356.94 | $ | $ | $ |
| Total area, sq. yds. | 1,398 | 1,501 | 1,115.65 | 5,885.01 | 1,740.15 |
| Cost per sq. yd. | 1.80 | 1.57 | 787 | 4,220 | 1,214 |
| *Includes material. | | | 1.42 | 1.40 | 1.4[illegible] |

## CONCRETE ENGINE FOUNDATION.*

**A. H. Shaw.**
**Engineer Central Coke and Coal Company, Bevier, Mo.**

The application of a reinforced concrete block for an engine foundation is something new and well worth considering by the man who is up against the proposition of having an unstable foundation under his engine and a limited time in which to do the work of making it solid. At the Central Coal and Coke Company's Mine No. 61, near Keota, Macon County, Mo., the following experiment was successfully accomplished.

This mine is equipped with electric haulage, and the generator is driven by an Erie 16-inch by 18-inch engine, making 500 revolutions per minute. This engine was installed about seven years ago on a foundation of sandstone, which, through some fault in its construction, began after six years of continued service to show signs of failing at a line three feet below the top of the foundation. The movement of the engine and foundation began to be so great that it was decided to brace it with 1½-inch iron tie-rods anchored to the solid part of the foundation, but this did not prove very successful, for while it gave temporary satisfaction, it was seen that in a very short time the foundation would be torn to pieces by the continual rocking back and forth of the engine at every revolution. The situation had reached a point where something had to be done, and quickly, but how to do it without shutting the mine down for a week or more was the question, as this would have meant a big loss to the company for they needed every ton of coal that could be hoisted.

The company's chief engineer, Mr. J. R. Stephens, proposed that a reinforced concrete block, of the same dimensions as the damaged part of the old foundation, be made. The block was 3 ft. 10 in. × 13 ft. 0 in. × 3 ft. 6 in. made of 1 : 1 : 2 concrete, reinforced, as shown in Fig. 1 (a) by placing three 12-pound steel rails 12 feet long about four inches from the top and three the same distance from the bottom of the block and three in the centre to serve as longitudinals; the cross reinforcement was made by placing 12-pound rails on top of longitudinals and spacing them six inches apart through the length of the block; vertical reinforcement was thought to be unnecessary.

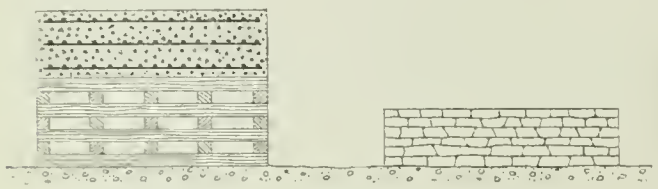
The forms for the concrete block were supported at the level shown in Fig. 1 (a), for with a block cast in this position it was not necessary to raise it when ready to be moved into place on the old foundation shown at (b). After the forms had been built and braced, wooden core boxes of sufficient size to leave ample room for the anchor bolts were set; care being taken in spacing these core boxes so that there would be no difficulty in setting the block over the

* In the "Mines and Minerals."

bolts. In casting, the concrete was well tamped into the corners and along the sides to insure absence of voids. The block was allowed to stand two weeks.

To put the block into position the engine was moved forward far enough for the fly-wheel to clear the end of the foundation and then off to one side. After the damaged portion of the foundation had been torn off and the newly exposed surface cleaned, the concrete block was rolled forward, let down over the anchor bolts and grouted into position. After this had set the engine was replaced. Enough of the old foundation was taken off so that there was fully an inch of clear space between the bottom of the engine bed and the top of the concrete block when the nuts on the anchor bolts had been screwed down the length of their own depth.

The cores in the concrete block were large enough to allow lateral motion for bringing the engine into alignment with the dynamo, and that was done by moving the engine so that the edges of the driving wheels and the driver pulley were all in the same straight line. The engine is supported on iron wedges and by shifting these wedges the engine was perfectly levelled both in direction of cylinder and crank-shaft. A form was then built around the founda-



(a) (b)

FIG. 1

tion, the top being level and projecting an inch above it. The engine bed was then firmly grouted in by first filling the core boxes and then bringing the entire surface to the level of the top of the forms. The iron wedges were not removed but remain permanently. The spaces surrounding the bolts in the bedplate openings were filled with molten sulphur.

The mine was closed on Wednesday at 3 p.m. and the work of moving the engine off the foundation began, and at 12 p.m. the concrete block was rolled into place, grouted in and allowed to stand twenty-four hours. This was considered long enough for the grout to have gotten sufficiently hard to permit putting the engine back into position. The engine was moved into position on the block in four hours, grouted in and allowed to stand until Saturday noon, when a trial run was made. No apparent movement could be detected in the foundation. On Monday morning work began as usual and the block method of renewing this foundation was a success.

The calculated weight of this block was 7½ tons and the estimated cost of this renewal was as follows:—

| | |
|---|---|
| Concrete 6.5 cubic yards at $8 | $52.00 |
| Forms (lumber and carpenter) | 4.50 |
| Blacksmith on reinforcements | 3.00 |
| Raising engine off foundation, tearing out old foundation and setting block and engine | 12.00 |
| | $71.50 |

The Steel Corporation's output of rails for the year compared as follows:—

| | 1907-8—Tons. | 1908-9—Tons. |
|---|---|---|
| Pig iron | 135,852 | 130,268 |
| Rails (Bessemer) | 117,607 | 126,733 |
| Rails (open hearth) | 25,321 | 31,732 |

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8146—September 22—Recommending to the Governor-in-Council for sanction agreement between the Canadian Collieries, Ltd., and the United Coal Fields of British Columbia, re sale and transfer of the franchise, rights, powers, railway and undertakings.

8147—September 22—Approving location plan of the C.P.R. Company's station at Mowbray, Man.

8148—September 22—Authorizing the C.P.R. to open for the carriage of traffic portion of line from Bolton to Bolton Junction, Ont.

8149—September 21—Directing the C.N.R. to provide and construct certain highways in the City of Fort William, Ont.

8150—September 22—Authorizing the Municipal Electric Light System of Listowel, Ont., to cross with its wires the track of the G.T.R. at that town.

8151—September 22—Authorizing the C.P.R. to construct, maintain, and operate spur in the Parish of Kildonan, Man.

8152—September 22—Authorizing the C.P.R. to construct industrial spur for the Empire Elevator Company at Fort William, Ont.

8153—September 22—Approving plan of proposed new iron bridge to be constructed by G.T.R. to replace present bridge at M.P. 121.22 near Ailsa Craig, Ont.

8154—September 22—Authorizing the C.P.R. to construct spur for J. Brodie & Son, mileage 3.79 from Stayner-ville Junction, P.Q.

8155—September 22—Granting leave to the Listowel Municipal Electric Light System to place its wires across the track of the G.T.R. Company, where the same crosses Mill Street, Listowel, Ont.

8156—September 22—Granting leave to the Listowel Municipal Electric System to place its wires across the track of the G.T.R. at Mill Street in said town.

8157—September 23—Granting leave to the Walford Rural Telephone Company to place its wires across the track of the C.P.R. at Irish Creek, Ont.

8158—September 23—Granting leave to the Bell Telephone Company to place its wires across the track of the N.C.R.R. near Bridgeburg, Ont.

8159—September 21—Dismissing application of the C.P.R. for leave to cross with its tracks the track of the G.T.R. in the town of Ingersoll, Ont.

8160—September 22—Dismissing application of the C.P.R. to cross with its track the track of the G.T.R., County of Oxford, at mileage 5.03, Ont.

8161—September 24—Approving location and detail plans of the C.P.R. Company's station at Belle Plain, Sask.

8162—September 24—Authorizing the G.T.R. to operate branch line in the City of Brantford, Ont., to the premises of Schultz Bros., Ltd.

8163—September 24—Authorizing the C.P.R. to operate branch, or industrial spur, for the Redcliffe Realty Company, Limited, Redcliffe, Alta.

8164—September 24—Approving and sanctioning location of the G.T.P. Company, Prince Rupert easterly, between mileage 150 and 180.74, Coast District, B.C.

8165—September 23—Granting leave to the Bell Telephone Company to cross the track of the G.T.R. at Howick

(Continued on Page 440.)

## ELECTRIC LOCOMOTIVES FOR THE BRITISH COLUMBIA ELECTRIC RAILWAY.

The British Columbia Electric Railway Company operate twenty miles of track in and around New Westminster, B.C., connecting this town with Vancouver, Stevest, Cloverdale, Huntingdon, Chilliwack, and several other Fraser Valley towns. They use a 4 ft. 8½ inch gauge and a 60 lb. T rail. Recently they have added to their equipment three electric locomotives.

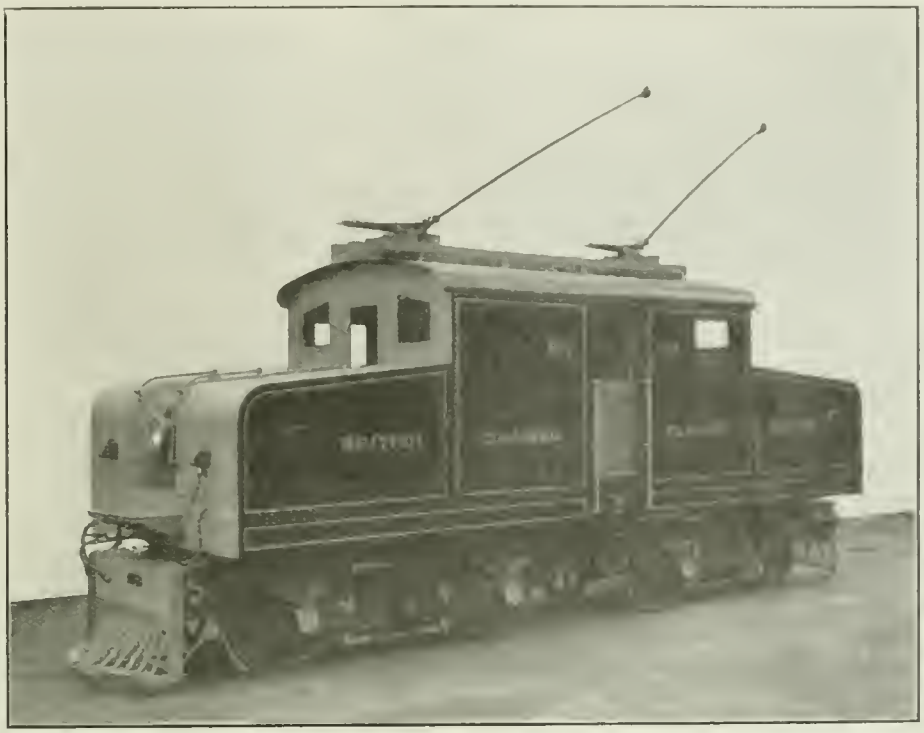


Fig. 1.—Electric Locomotive for the British Columbia Electric Railway.

These locomotives were built and supplied by Messrs. Dick, Kerr & Company, the electrical equipment being manufactured at their electrical works at Preston, and the trucks and mechanical portion at their general engineering works at Kilmarnock.

The locomotives are of the articulated truck four-axle type, with one motor mounted upon each axle. The maximum rated tractive effort is 16,000 lb. drawbar pull, and the maximum instantaneous effort is 25,000 lb. A feature of special interest in the truck arrangement is that the body of the locomotive rests upon two four-wheeled trucks coupled together by a massive hinge having lateral flexibility but vertical rigidity thereby enabling the rear trucks to resist any tendency to tilt under the action of the forward truck, and vice versa. The centre pins and cab platform framing are not subjected to any longitudinal stress, except that due to its own inertia when starting and stopping, the whole pull of the motors being transmitted direct from the motors through the trucks. Suitable arrangements are made to allow the trucks to radiate when passing round a curve. The spring suspension is of the locomotive type, the weight being carried by semi-elliptic springs resting on the journal box saddles.

Fig. 1 shows the general appearance of one of the locomotives, and Fig. 2 gives a view of the interior of the cab. Here can be seen the two master controllers one at each end of the cab, the contactor boxes, circuit-breakers, switches, etc. The control equipment is of the standard Dick-Kerr multiple-unit type, with series magnets operating the various contactors. The resistances are placed in the sloping ends of the superstructure.

The motor equipment consists of four Dick-Kerr 12a motors. When operating on a 600 volt circuit each motor will give a tractive effort of 4,040 lb. on the periphery of the 42-inch wheels, and a speed of 15 miles per hour at the one-hour rating. Each motor is fitted with reduction gear having a ratio of 3.64 to 1. The armature bearings of the motor are lubricated by oil rings, which are specially designed to prevent flooding when running at high speeds. The axle bearings are lubricated by a system of wicks which are immersed in oil wells. No grease is used as an emergency lubricator. The whole of the gearing of the

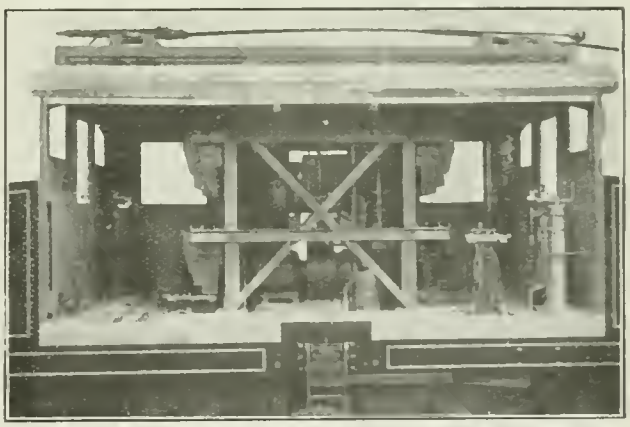


Fig. 2.—View Showing Interior of Cab of Locomotive

motor is contained in a malleable iron oil-tight gear box, which is provided with suitable stiffening ribs. It is supported by the axle bearing at one end and by the pinion bearing and motor shell at the other end. The motors are designed and arranged for forced ventilation, the air being blown into the motor shell at the end farthest from the commutator, and passing out at suitable openings provided at the commutator end.

The air for the forced ventilation is obtained by means of a centrifugal blower situated in the centre of the cab (see Fig. 2) and driven by a Dick-Kerr motor. The controller for operating this motor is situated near the right-hand master controller, seen in Fig. 2. In addition to the blower for the motors, there is an electrically-driven air compressors with suitable air reservoirs for the air-brake equipment, the locomotive being fitted with combined straight and automatic air brake. The compressor for the brake equipment is mounted above the motor-driven blower in the cab.

Two current collectors are provided, these being of the straight under-running trolley type, the current being collect-

**B. C. Electric Lines.**

ed from an overhead trolley line. The trolleys are equipped with retrievers. The following details of the equipment are of interest:—

| | |
|---|---|
| Number of motors | 4 |
| Gear ratio | 3.64 to 1 |
| Number of driving wheels | 8 |
| Diameter of driving wheels | 42-inch |
| Total wheel base | 24 ft. 6 inch |
| Wheel base of each truck | 8 feet |
| Length overall | 35 ft. 7 inch |
| Length of main cab | 16 ft. 5 inch |
| Height of cab above rail level | 14 ft. 1½ in. |
| Width of cab | 9 ft. 8 inch |
| Total weight of locomotive | 50 tons |

The Canadian agents for Dick Kerr & Co., are Chapman & Walker, Toronto, Ont.

## COMING MEETINGS.

**American Railway Bridge and Building Association.**—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

**American Gas Institute.**—October 20. Annual meeting at Detroit, Mich. Secretary, A. B. Beadle, 29 W. 39th Street, New York City.

**National Association of Railway Commissioners.**—Nov. 16. Annual meeting at Washington, D.C. Secretary, Martin S. Decker, Albany, N.Y.

**America Railway Association.**—Nov. 17. Annual meeting at Chicago, Ill. Secy., W. F. Allen, 24 Park Place, N.Y.

**American Society of Municipal Improvements.**—Nov. 9-11. Annual convention at Little Rock, Ark. Secy., A. P. Folwell, 239 West 39th St., New York City.

## GUELPH'S WATER SUPPLY.

**A. E. Oakley, C.E.**

The city of Guelph, with a population of 14,000, formally inaugurated its new system of water supply on the 23rd September, the Lieutenant-Governor of the Province, Hon. J. M. Gibson, being the guest of honor. Up till this time the city has derived its supply from the River Speed, from which the water flowed practically direct to pumps. Needless to say, the supply was not of a very wholesome character, due to contamination, and typhoid fever cases were numerous. Several schemes for filtering the water on its course from the river were tried, but with indifferent success; so that in 1907 the Water Commissioners decided to consult Messrs. Davis & Johnston, of Berlin, as to the practicability and cost of collecting springs at Arkell, a distance of four miles east of Guelph, where an abundant supply of pure water could be obtained. The report they received confirmed their idea that this was practicable, and also advised the installation of a storage reservoir, new pumps, and standpipe. The report was adopted, and the citizens voted $125,000 for carrying out the work as outlined. The engineers who reported on this scheme were engaged, and the writer as resident engineer. The satisfactory results following the operation of the system have fully justified the Commissioners in the course they have

**Stand Pipe, 500,000 gallons.**

taken, and Guelph has now an abundant supply of pure water, sufficient for many years to come.

The intention of the writer in the present article is to describe briefly some of the features of the work of construction in the hope that it will be of interest to engineers.

The springs at Arkell are situated in the valley of the River Speed, and those at present in use are six in number. They vary considerably in flow, that of the largest being 1¼ million, the smallest 56,000 imperial gallons in twenty-four hours. The springs rise on the side of the hill out of a coarse gravelly ground, underneath which is limestone rock. To protect the springs from contamination about 170 acres of land was bought by the city and has been carefully

fenced in. This land the Commissioners propose planting with trees.

The work of collecting springs consists of a concrete chamber, 4 ft. by 3 ft., built in the most suitable position. From this chamber open-jointed pipes are laid, following the springs into the side of the hill and in other directions where smaller springs could be obtained These branches were laid to an average depth of 6 ft. and covered with 1 ft. of washed gravel, and trench refilled with the excavated material. A weir was built in the chamber, so that the flow can be measured periodically to see if the flow decreases or otherwise. From the weir chamber a cement jointed pipe is laid to main conduit, the connection being made by building a concrete chamber 3 ft. by 3 ft. All chambers are covered with reinforced concrete slabs, with manholes where necessary. It will be gathered from the preceding description that the springs are, as far as practicable, protected in every possible way from the risk of contamination, the water not being exposed until it reaches the valve-house at the reservoir.

The main conduit consists of a 24-inch diameter vitrified pipe, laid to a grade of 1 in 1,000, the average depth of pipe being 5 feet 6 inches.

Nothing of especial interest occurred in the work. The usual methods of pipe-laying were employed as in sewer

**Pipe Line during construction.**

construction, with the exception, perhaps, of the manner of making joints, which was specified briefly as follows: Strands of yarn to be cut eight inches longer than circumference of the pipe, yarn to be well soaked in cement grout and thoroughly caulked into joints; no strands of yarn to overlap in same place. The joint to be filled in this manner and finished off with the usual fillet of cement. The fact that one section of this conduit is laid as an inverted syphon for a distance of 1,800 feet under a five-foot head, and is watertight, shows that this system of making joints is very satisfactory. Great care, however, should be exercised, and, in the opinion of the writer, an inspector should be on the ground to see each joint made, as it is almost impossible to get the work done properly without constant supervision, especially where water is met with in the excavation, as was the case in places where the conduit was laid.

The conduit in its course cityward crosses under the C.P.R., and also under the river. No difficulty was experienced at either place. In the latter the water in the river was about four feet deep, and the customary way of damming off half the river, pumping, excavating and laying pipe for that distance, then turning the flow of water over the pipe already laid and laying the next part was followed successfully.

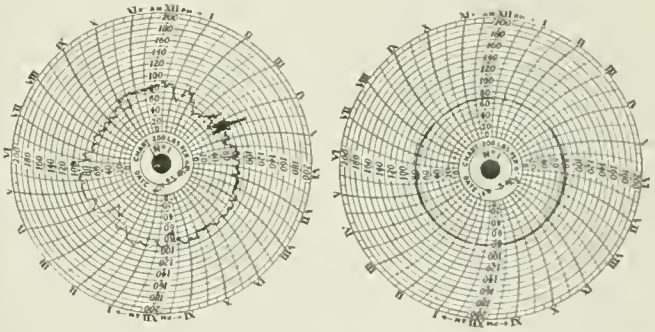
Pipes under the river were of cast-iron, owing to the greater head that they were subjected to. They were laid

**Pipe Line and Retaining Wall.**

as an inverted syphon, a concrete chamber with air vent being built at either end.

The construction of the concrete storage reservoir presented some rather unusual difficulties, owing to the fact that the site was in part of the open reservoir then used by the city, and that the supply could not be interfered with whilst work was in progress.

To overcome this difficulty the engineers decided to lay a 14-inch cast-iron pipe, with lead joints, in the bottom of the old reservoir, the level of which was three feet lower than the floor level of the new reservoir. Pipes were jointed together on trestle work and lowered eight feet into place



**Pressure record discs.**

by means of chain blocks, the blocks being spaced about twelve feet apart. In this manner 200 feet of pipe were successfully laid. Dams were then built, water pumped out, and excavation and grading done. Several springs or leakages from the old reservoir were met with, and diverted to pumps by means of open-jointed tile. In adopting this method no difficulty was encountered in the laying of concrete. One pulsometer pump and one duplex pump was sufficient to keep excavation dry during the progress of work. The dimensions of the reservoir and details of same are shown on the accompanying plan. The capacity is about 500,000 imperial gallons. Depth of water is usually eight feet, but can be

increased to a depth of ten feet for reasons dealt with in the description of the valve-house.

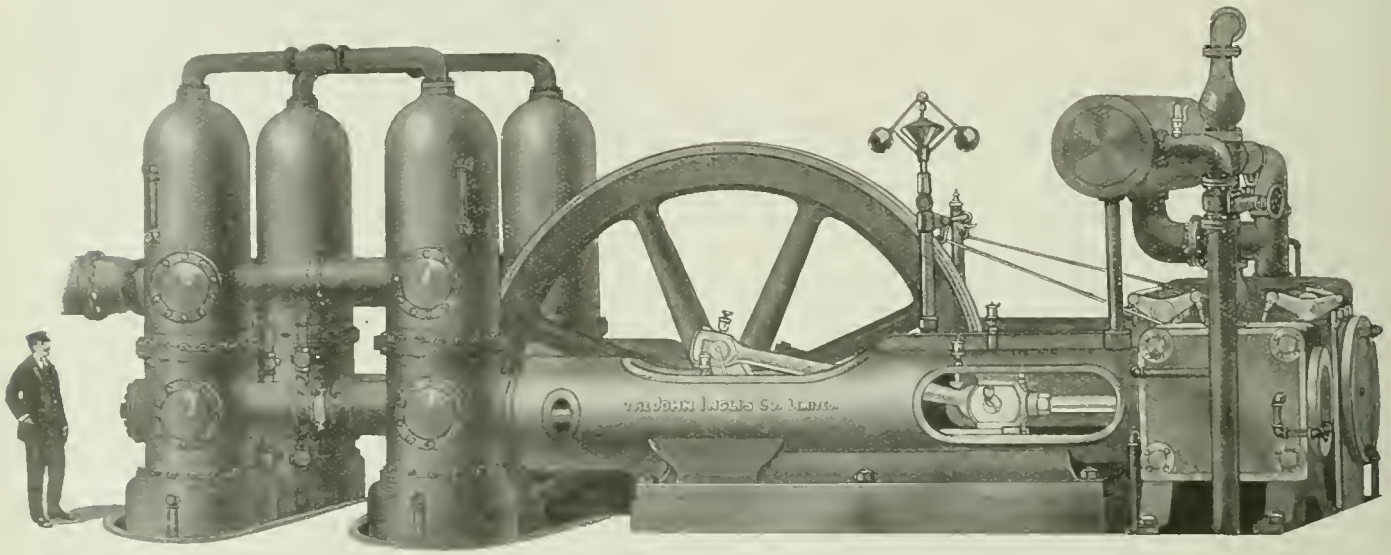
The floor of reservoir consists of concrete, 8 inches thick, reinforced with ½-inch steel rods, spaced 5½ inches, centre to centre, and also with ¾-inch rods, laid longitudinally between columns. This reinforcing was calculated to resist the static pressure from beneath when at any time the reservoir should be emptied, the level of water outside being four feet higher than floor level.

The walls are of plain concrete, 2 ft. 6 in. thick at base, and sloping on the inside to 1 ft. 6 in. at the top. Columns for supporting roof are also plain concrete, 1 ft. 6 in. square. Beams are of reinforced concrete, the reinforcing consisting of three 1⅛-inch. rods, the centre rods being bent up at ends. In addition to this, two ½-inch rods, bent as shown, are placed to anchor the ends of beams to walls, and over piers two ½-inch rods 8 feet long are placed for shear. The roof consisted of concrete 4 in. thick, reinforced with ½-inch steel rods, spaced 5½ in., centre to centre; longitudinal rods are also placed as shown. The roof slab is continuous from end to end of reservoir. The concrete for floor and roof was composed of one part cement, two of sand and four parts broken stone. That for the walls and columns was composed of one part cement, 2½ parts sand and five parts broken stone. The concrete was mixed by a "continuous mixer," but materials were carefully gauged in boxes, no automatic appliances being allowed. Where the conduit discharges into the reservoir an overflow chamber and valve-house has been constructed, also of concrete. There are two valves here. The object of these valves is, in the one case, to allow of reservoir being emptied, the water meanwhile discharging through overflow pipe into old reservoir, from which the water could be drawn through the 14-inch pipe mentioned previously as being laid under the new reservoir, a valve being placed on this pipe for this purpose. The second valve in the valve-house is an overflow. This can be operated so that the overflow level will be considerably higher than any high water mark of the river ever recorded or remembered by the inhabitants.

The valve-house is built partly over a section of the reservoir. An opening in the roof, railed off, provides an opportunity for visitors to view the water as it discharges from the conduit into the reservoir, this being the only place it is visible until it reaches the consumers. From the reservoir the water flows to the pump well, from which it is pumped by a 3,600,000 imperial gallon horizontal, cross-compound engine, designed to work against a head of 240 feet, including suction, when supplied with 125 pounds steam pressure per square inch at throttle. Discharge from pumps enters a 14-inch and 12-inch main to city and standpipe.

The standpipe is situated on a hill adjacent to the city, the dimensions being 100 feet in height and 30 feet diameter. Foundation consists of concrete 7 feet 6 inches thick, and is hexagonal in shape. The standpipe pressure at the centre of the city records 80 pounds per square inch. However, in case the necessity arises, owing to fire, to increase this pressure, an electrically operated valve is to be placed on the force main at the base of the standpipe, and water can then be pumped direct to the main. This valve is to be operated from the pump-house.

Fig. 3 is a reproduction of two records taken from the pressure gauge in the city hall. The first one shows the pressure on November 25th, 1908, before the stand pipe connections were made, and when the pumps were pumping direct into the city mains without the standpipe for overflow. The second record was made January 5th, 1909, and clearly indicates the uniform pressure now secured.



**Cross Compound Pumping Engine, built by The John Inglis Company, Limited.**

The following analysis, which is a good average result, shows the water to be very pure:—

| | |
|---|---|
| Total solids | 336 parts per million |
| Chlorine | 9 parts per million |
| Free ammonium | merest trace |
| Albuminoid ammonium | .038 parts per million |

| Contract. | Contractor. | Price. |
|---|---|---|
| Supplying 24-inch tile | Lytle Tile Co., Buffalo, N.Y. | $24,000 00 |
| Laying same | J. Conn & Co., Windsor | 24,078 00 |
| Iron pipe | Gartshore, T., Hamilton | |
| Laying force main | J. Conn & Co., Windsor | 2,825 00 |
| Concrete reservoir | C. H. Conery, Guelph | 8,993 00 |
| Pumps | J. Inglis & Co., Toronto | 14,400 00 |
| Standpipe | Toronto Iron Works, Ltd. | 9,250 00 |

The Guelph Waterworks system is managed by a commission consisting of G. B. Ryan, chairman; R. L. Torrance, secretary, and the mayor. Mr. J. J. Hackney is the manager of the whole system, the Commissioners dealing only with matters of policy.

# THE ACTION OF FROST ON CEMENT AND CEMENT MORTAR, TOGETHER WITH OTHER EXPERIMENTS ON THESE MATERIALS.*

By Ernest R. Matthews, Esq.,† and James Watson, Esq.

This paper describes in detail a series of experiments, extending over the past two years, made by the writers, in order to ascertain:—

The effects of frost, and alternate frost and thaw, on the tensile strength of cement and cement mortar when mixed with—

(a) fresh water, cold or warm;

(b) sea-water;

The temperature below which it is detrimental to mix Portland cement concrete;

The effects produced by immersing concrete in—

(a) fresh water, hard or soft,

(b) sea-water;

Absorption of water by (dry) cement;

Quantity of water required to be added to cement to produce complete hardening.

The results of these experiments are not only interesting, but should prove of value to engineers generally.

The Hull Cold Storage Company, of Hull, England, kindly allowed the writers to use its refrigerating rooms in order to obtain the degrees of frost necessary for these experiments. The cement used was that manufactured by Robson's Cement Company, of Hull, and all the experiments were carried out at the laboratories of that firm, in Hull, these being kindly placed at the disposal of the writers.

### Cement Used in Experiments.

The particulars of the cement used are as follows: Made on January 28th, 1907. Residues on a 5 776-sieve (that is, having 76 meshes per linear inch) = 0.5%; residues on a 10,000-sieve (having 100 meshes per linear inch) = 2.0%; residues on a 32 400-sieve (having 180 meshes per linear inch) = 11.5% (showing that the cement was ground extremely fine). Specific gravity = 3.112; flour = 54.5%; Le Châtelier tests, expansion = 2.7 mm.; Faija bath test, cement pat sound and hard; time of set of neat cement with 25% water: Initial set = 35 min.; permanent set = 6 hours, in a room kept at a temperature of 60° Fahr.

### Tensile Strains. Neat Cement.

7 days = 685 lb. per sq. in. British Standard Test, 400 lb. per sq. in.

14 days = 787 lb. per sq. in.

28 days = 875 lb. per sq. in. British Standard Test, 500 lb. per sq. in.

It will be seen that these results are well above the British Standard Tests.

### Tensile Strains. One Part Cement and Three Parts Sand.

Mixed with three parts by measure of sand, and with no hammering of briquettes into moulds, its mean strength was:—

7 days = 200 lb. per sq. in. British Standard Test, 120 lb. per sq. in.

14 days = 277 lb. per sq. in.

28 days = 333 lb. per sq. in. British Standard Test, 225 lb. per sq. in.

* Read before the American Society of Civil Engineers and published in Vol. XXXV., No. 1, Page 1.

†Borough Engineer of Bridlington, England.

### Chemical Analysis.

| | Percentage |
|---|---|
| Insoluble Residue | 0.82 |
| Silica | 20.43 |
| Alumina | 9.10 |
| Oxide of iron | 1.95 |
| Lime | 62.65 |
| Magnesia | 1.25 |
| Sulphuric anhydride | 1.38 |
| Loss on ignition | 1.66 |
| Alkalies and loss | 0.76 |
| | 100.00 |

The sea-water used in these experiments was taken from the North Sea; the fresh water was drawn from the Hull Corporation mains. To obtain the soft water, the temporary hardness of this water was removed, the permanent hardness being from 3 to 4 degrees.

The experiments herein will be compared with the tests just given, which will be referred to as the "Normal Test."

### Effects of Frost.

The effects of frost, and alternate frosts and thaw, on the tensile strength of cement and cement mortar when mixed with (a) fresh water—cold or warm, (b) sea-water; and the temperature below which it is detrimental to mix Portland cement concrete, were determined by the following experiments:

Experiment A.—In this experiment the writer set out to discover the weakening effect, upon freshly mixed cement, of continuous light frost, temperature 29° Fahr., and of heavy frost, 15° Fahr. Nine briquettes were made with neat cement, 20 per cent. water, in the laboratory, the temperature of the air being 60° Fahr. These were taken from the moulds 24 hours after gauging and placed in cold stores, temperature 29° Fahr., and were broken at seven and twenty-eight days, respectively, the average tensile strength being:

At 7 days = 610 lb. per square inch.

At 28 days = 905 lb. per square inch.

These results are compared with the normal tests as follows:

Tensile strength in pounds per square inch.

| | Normal tests, 24 hours in air at 60° Fahr., in water remainder of time. | In air at 60° Fahr for 24 hours then 29° Fahr. for remainder of time. |
|---|---|---|
| 7 days | 685 | 610 |
| 28 days | 875 | 905 |

In the 7 days' test it will be observed that there is a decrease of 10.9 per cent. in tensile strength, and an increase of 3.4 per cent. in the 28 days' test.

Experiment B.—Nine briquettes, made in the same manner as in Experiment A, were placed at 60° Fahr. Three were taken out at the end of 2 days, and placed in cold storage for 25 days; three more, at 7 days, for 21 days, and the other three, at 14 days, for 14 days. All were broken at 28 days, the result being as follows:

Tensile strength in pounds per square inch.

| | Normal test in air, 60° Fahr. for 24 hours, then in water. | In water at 60° Fahr for 2 days, then in air at 29° Fahr. | In water at 60° Fahr. for 7 days, then in air at 29° Fahr. | In water at 60° Fahr for 14 days then in air at 29° Fahr. |
|---|---|---|---|---|
| 28 days | 875 | 912 | 977 | 942 |

Experiment C.—Nine briquettes, made as before, were allowed to harden in air for 7 and 28 days at 60° Fahr., the result being:

Average tensile strength at 7 days = 443 lb. per sq. in.

Average tensile strength at 14 days = 525 " "

Average tensile strength at 28 days = 775 " "

| Days. | 7, 14 and 28 days in air at 60° Fahr. | 24 hours in air at 60° Fahr., then in water. |
|---|---|---|
| 7 | 443 | 685 |
| 14 | 525 | 787 |
| 28 | 775 | 875 |

Experiment C1.—

Sand and Cement Tests (3 to 1): Same as Experiments A, B, and C.

| Days | Normal test | A | B | C |
|---|---|---|---|---|
| 7 | 200 | 163 | ..... | 220 |
| 14 | 277 | 270 | ..... | 250 |
| 28 | 353 | 342 | B2. 317<br>B7. 305<br>B14. 243 | 322 |

Experiment D.—Effect of Alternate Frost and Thaw.—The briquettes were allowed to remain for 24 hours under damp flannel, then in water for three days (60° Fahr.), then in water at the cold stores (temperature varying from 29° to 60° Fahr.). The briquettes were changed every three days.

| Days | Neat | 3 to 1 | Normal Neat | 3 to 1 |
|---|---|---|---|---|
| 14 | 787 | 252 | 787 | 277 |
| 28 | 813 | 322 | 875 | 353 |

Experiment E.—This test was the same as A or D, but the briquettes were gauged with warm water; temperature, 100° Fahr.

| Days | A Test Neat | 3 to 1 | Normal Neat | 3 to 1 |
|---|---|---|---|---|
| 7 | 352 | 133 | 610 | 163 |
| 14 | 705 | 205 | ... | 270 |
| 28 | 728 | 230 | 905 | 342 |

Experiment F.—(Salt-Water Immersion).—Nine briquettes were mixed with fresh water, and, after 24 hours, were immersed in sea-water, and broken at 7, 14 and 28 days.

| Days | Neat (20% water) | 3 to 1 (10% water) | Normal Neat | 3 to 1 |
|---|---|---|---|---|
| 7 | 770 | 242 | 685 | 200 |
| 14 | 742 | 278 | 787 | 277 |
| 28 | 812 | 360 | 875 | 353 |

Experiment G.—Nine briquettes were mixed with sea-water (same test as before).

| Days | Neat | 3 to 1 | Normal Neat | 3 to 1 | Mixed with fresh water and immersed in sea-water Neat | 3 to 1 |
|---|---|---|---|---|---|---|
| 7 | 693 | 180 | 685 | 200 | 770 | 242 |
| 14 | 775 | 287 | 787 | 277 | 742 | 278 |
| 28 | 773 | 293 | 875 | 353 | 812 | 360 |

Initial set, 9 minutes; final set, 6 hours.

Experiment H.—Nine briquettes were mixed with sea-water, and, after 24 hours under damp flannel, were immersed in fresh water for the remainder of the time.

| Days | Neat | 3 to 1 | Normal Neat | 3 to 1 |
|---|---|---|---|---|
| 7 | 628 | 150 | 685 | 200 |
| 14 | 737 | 255 | 787 | 277 |
| 28 | 713 | 297 | 875 | 353 |

Experiment K.—Same test as A, but the briquettes were kept in a temperature of 15° Fahr. in cold storage.

| Days | K.—Heavy Frost Neat | 3 to 1 | A.—Light Frost Neat | 3 to 1 | Normal Neat | 3 to 1 |
|---|---|---|---|---|---|---|
| 7 | 405 | 57 | 610 | 163 | 685 | 200 |
| 28 | 595 | 145 | 905 | 342 | 875 | 353 |

The briquettes were taken from the cold stores to the laboratory, two miles away, and were broken in a temperature of 60° Fahr., 45 minutes after leaving the cold stores.

Experiment L.—The briquettes, 24 hours after gauging, were put into water at 60° Fahr. for 6 days, then placed in the cold stores at a temperature of 15° Fahr. for the remainder of the time.

| Days | Neat | 3 to 1 | Briquettes placed in air at 60° Fahr. for a day or two after having been in cold stores at 15° Fahr. for 28 days. Neat | 3 to 1 | Normal Neat | 3 to 1 |
|---|---|---|---|---|---|---|
| 28 | 700 | 217 | 875 | 315 | 905 | 342 |

Experiment M.—The briquettes were put directly into the cold stores at 29° Fahr. for 7 days.

| Days | Neat | Normal—Neat |
|---|---|---|
| 7 | 480 | 685 |
| 28 | 595 | 875 |

Experiment N.—The briquettes were made with neat cement, and placed, some in the air at a temperature of 60° Fahr., and others in air at a temperature of 29.3° Fahr. (2.7° of frost). In 15 minutes those in air at 60° Fahr. were still soft, while those subjected to frost had just frozen hard at the expiration of that time. Briquettes mixed with sand and cement (3 to 1) were subjected to a similar test. At the expiration of 15 minutes those in a temperature of 60° Fahr. were still soft, while those in a temperature of 29.3° Fahr. had just frozen hard; and at a temperature of 27° Fahr. (5° below freezing point, Fahr.) were frozen very hard, indeed, at the expiration of that time.

Conclusions from the Foregoing Experiments.—These investigations have led the writers to the following conclusions:

(1) That light frost occurring 24 hours after the cement has been gauged, as indicated in Experiment A (3° of frost, or thereabouts), is detrimental to freshly mixed Portland cement, but only for a short time, and that at the end of 28 days it has quite regained its normal strength. If the frost occurs immediately after the cement has been gauged, the effect is more detrimental, and would appear to be permanent (see Experiment M). A minimum quantity of water should be added in frosty weather.

(2) That heavy frost (17° of frost, or thereabouts) has a most injurious effect (permanent) upon freshly mixed cement (neat), and cement mortar, as shown in Experiment K.

(3) That a light frost (3° of frost, or thereabouts), as indicated in Experiment A, does not affect cement or cement mortar if it has attained 2 days' set previous to the occurrence of the frost (Experiments B, C, and D).

(4) That the detrimental effect of light frost upon cement mortar (3 to 1) occurs more immediately than upon neat cement, but that cement mortar recovers from the ill effects of frost more rapidly than neat cement. At the end of 14 days it has quite recovered (Experiment C).

(5) That the mixing of cement or cement mortar with warm water (temperature, say, 100° Fahr.), which is sometimes done in frosty weather, and has been recommended by some engineers,* has a permanently injurious effect upon

* Minutes of Proceedings, Inst. C.E., London, Vol. CXXXIV, p. 384.

cement and cement mortar. This will be seen by reference to Experiment E.

(6) That neat cement immersed in fresh water immediately after becoming set, and remaining in water, has a much greater tensile strength than when remaining in air (Experiment C), the former being 55 per cent. stronger than the latter at the end of 7 days, 50 per cent. stronger at 14 days, and 11.3 per cent. stronger at 28 days. In 3 to 1 cement mortar, however, the result is different, the tensile strength being practically the same under both conditions.

(7) That it increases temporarily the tensile strength of cement and cement mortar to immerse them in sea-water 24 hours after gauging, instead of immersing them in fresh water; but the increased strength is only temporary (Experiment F).

(8) That there is an immediate reduction in the tensile strength of briquettes mixed with sea-water and immersed in sea-water (Experiment G) over those mixed with fresh water and immersed in sea-water (Experiment F). At the end of 14 days the strength of the former equals that of the latter, but after that period a depreciation again sets in, so that at 28 days there is a deficiency of 5 per cent. in the tensile strength.

(9) That the initial set of briquettes mixed with sea water is 9 minutes; permanent set, 6 hours. When mixed with fresh water, the former is 35 minutes; the latter, 6 hours (Experiment G).

(10) That cement and cement mortar mixed with sea-water, and immersed in fresh water 24 hours afterwards, have less tensile strength than when mixed with fresh water and immersed in fresh water (Experiment H).

(11) Experiment L shows that 17° of frost for 28 days does not kill the process of hardening in the briquette, but only delays it.

(12) It would appear from Experiment N that it is detrimental to concrete to mix it when the temperature is below 29.3° Fahr. (2.7° of frost), that being the freezing point of cement and concrete.

### The Effects Produced by Immersing Concrete in Fresh Water (Hard or Soft), and in Sea-Water.

Neat Cement.—Neat-cement briquettes (mixed with 20 per cent. of fresh water) were immersed in fresh water (both hard and soft) and in sea-water after being in the moulds for 24 hours. In each case the absorption finished at the end of the seventh day: (1) The water absorbed by the briquettes in hard water at the end of the seventh day = 3.46 per cent.; (2) by the briquettes in soft water = 2.92 per cent.; (3) by the briquettes in sea-water = 3.92 per cent.

Sand and Cement, 3 to 1.—As in the case of neat cement, just described, no absorption took place after the seventh day. (1) The briquettes in hard water absorbed at the end of the seventh day 3.4 per cent. of water; (2) in soft water, 3.4 per cent.; (3) in sea-water, 4.5 per cent. In the case of the neat cement, and sand and cement briquettes, similar to the foregoing, but exposed to air for 7 days previous to immersion in water, the following results were obtained:

With neat cement during 7 days' exposure to air, the loss in weight, was 1.7 per cent.; then, after 24 hours' immersion in (1) hard, (2) soft, and (3) sea-water, the increased absorption = 1.7 per cent., just counterbalancing the previous loss. On continued immersion a further gain of only 0.3 per cent. in weight was obtained. The results of tensile tests at 28 days were: (1) = 875 lb.; (2) = 760 lb.; and (3) = 835 lb. per square inch. The lower absorptions were most probably due to the partial set of the cement in the centre of the briquettes during the 7 days' drying in the air, and the prevention of the free percolation of the water through it.

With sand and cement, during 7 days in air, the loss of moisture was 2.2 per cent.; then, after 24 hours' immersion, the gain was: (1) in hard water = 3.4 per cent.; (2) in soft water = 2.0 per cent.; and (3) in sea-water = 2.8 per cent. The results of tensile tests at 28 days were: (1) = 360 lb., (2) = 360 lb., and (3) = 330 lb. per square inch.

Conclusions from the foregoing Experiments.—(1) That no absorption takes place in neat cement, cement mortar, or concrete after immersion in water for 7 days.

(2) That neat cement immersed in hard fresh water for 7 days absorbs 0.54 per cent. more than when immersed in soft fresh water for the same period.

(3) That if immersed in sea-water for 7 days it absorbs 0.46 per cent. more than when immersed in hard fresh water, and 1.0 per cent. more than when immersed in soft fresh water.

(4) That cement mortar (3 to 1) absorbs the same quantity when immersed in either hard or soft fresh water, but when immersed in sea-water it absorbs 1.1 per cent. more.

(5) That neat cement and cement mortar, when immersed in hard fresh water, have practically the same absorption in both cases. That neat cement immersed in soft fresh water absorbs 0.48 per cent. less than cement mortar (3 to 1), and that cement immersed in sea-water absorbs 0.58 per cent. less than cement mortar.

(6) That when neat cement is exposed to air for 7 days after gauging it loses 1.7 per cent. of its weight, but when immersed for 24 hours in water, either hard or soft fresh water, or sea-water, it absorbs 1.7 per cent., which just counterbalances the previous loss.

(7) That after this loss has been made good, and the immersion of the briquettes is continued, there is a further gain of 0.3 per cent., which averages 1.43 per cent. less than the absorption which takes place when cement is immersed in water 24 hours after gauging.

(8) That cement mortar (3 to 1) exposed to air for 7 days after gauging loses 2.2 per cent. of its weight; but after 24 hours' immersion in hard fresh water the absorption is increased to 3.4 per cent.; in soft water it is 2.0 per cent., and in sea-water it is 2.8 per cent., showing that soft water is absorbed more slowly than hard water, and that sea-water is also more slowly absorbed than hard fresh water.

### Absorption of Water by (Dry) Cement.

Experiment 1.—Dry cement was compressed into moulds with a press, the same amount in each mould. The moulds were then allowed to stand in water for 24 hours. The result was an average increase in weight of 14.9 per cent.

Experiment 2.—The cement in the moulds was then changed so that there would be a variation in thickness of ⅛-inch. The result was that the absorption varied correspondingly from 13.2 to 17.1 per cent. The writers then took a larger quantity of cement and compressed it into the same bulk as at first, and found that the absorption after 12 hours = 12.3 per cent.; after 24 hours = 14.4 per cent; after 48 hours = 14.8 per cent.; after 4 days = 15.1 per cent.; after 8 days = 15.4 per cent.; after 31 days = 16.8 per cent. (constant).

Conclusions from the foregoing Experiments.—(a) That when neat cement is immersed in water for 24 hours it absorbs from 14.4 to 14.9 per cent., according to the thickness of the cement;

(b) That the absorption increases to 16.8 per cent. at the end of 31 days' immersion;

(c) That no absorption takes place after 31 days' immersion.

**Quantity of Water Required to be Added to Cement to Produce Complete Hardening.**

According to the formula laid down by Le Châtelier,*

$3CaO\ SiO_2 + \text{water} = CaO\ SiO_2\ 2\tfrac{1}{2}\ H_2O + 2Ca\ (Oh)_2$

35.4 per cent. of water would be required to be added to cement for complete hardening, and the hardened cement, therefore, would contain 26.2 per cent. of water in a combined state. From the figures the writers now give, this is found to be by no means the case. Possibly the re-action is not so complete, as Le Châtelier works it out by theory, and, although more water is combined by using an excess in gauging, yet the test becomes less and the strength is impaired, for Dr. Michaelis† found that, by sealing up some very finely ground cement with 150 per cent. of water for four weeks and then drying it over sulphuric acid, a loss on ignition was shown which equalled 27.5 per cent. of water absorbed. The results of the writers' experiments are as follows:

Experiment A.—Neat-cement test pieces gauged with 20 per cent. water, after 14 days' immersion in water, gave free moisture = 11.75 per cent., combined = 9.7 per cent.,; after 28 days' immersion they gave free moisture = 12.14 per cent.; combined = 10.9 per cent.

Experiment B.—Mortar briquettes, with 3 sand to 1 cement, gauged with 10 per cent. of water, after 24 hours were immersed in water and kept there for 7, 14 and 28 days:

| | Free water at 105° cent. Percentage. | Combined water. Percentage. |
|---|---|---|
| At 7 days ..... | 9.44 | 9.20 |
| " 14 " ..... | 8.49 | 10.58 |
| " 28 " ..... | 8.68 | 10.29 |

Experiment C.—Neat cement test pieces were gauged with 20 per cent. of water, and, after 24 hours under damp flannel, were immersed in fresh water for periods up to 18 months.

| | Free water at 105° cent. Percentage. | Combined water. Percentage. |
|---|---|---|
| After 3 days ..... | 8.0 | 6.4 |
| " 7 " ..... | 8.9 | 7.0 |
| " 28 " ..... | 9.0 | 12.38 |
| " 3 months ..... | 9.25 | 13.05 |
| " 6 " ..... | 9.55 | 12.95 |
| " 12 " ..... | 9.40 | 12.90 |
| " 18 " ..... | 9.82 | 12.20 |

Experiment D.—Other test pieces, made of different cement, were also tried, 20 per cent. of water being used for gauging, with the following results.

| | Free water. Percentage. | Combined water Percentage. |
|---|---|---|
| After 24 hours ..... | 8.5 | 3.3 |
| " 48 " ..... | 7.45 | 11.5 |
| " 72 " ..... | 7.10 | 7.7 |

* Annales des Mines, 1887.

† Thonindustrie-Zeitung, 1899.

Experiment E.—Frozen Test Pieces.—The cement was gauged with 20 per cent. of water, and, after 24 hours under damp flannel, was placed in cold storage at 15° Fahr. (17° of frost) for 6 days. The free water = 10.29 per cent.; combined water = 5.92 per cent There was no active hardening of the cement.

Conclusions from the foregoing Experiments.—That from the quantity of water absorbed by cement and cement concrete the writers are unable to determine precisely its ultimate effect upon the hardening of the concrete. It depends entirely upon physical conditions, such as the porosity of the concrete. When an excess of water is added, there seems to be a loss due to evaporation during the few hours after gauging; then, although immersed in water, the percentage of uncombined water remains constant, while the percentage of combined water increases until it attains a maximum of approximately 12 per cent. This occurs also with gauged cement exposed to open air, the only difference being that the quantity of free moisture gradually diminishes, owing to evaporation. In the case of sand and cement mortar, more water is absorbed in proportion to the quantity of cement used; this, most probably, is due to the greater porosity of the mass. The same result, it will be noted, occurs in the case of cement compressed into moulds, less water being absorbed in the same period when the mass is denser in bulk; so that, in the case of fireproof floors and reinforced work, the denser the concrete, and with no more than the maximum quantity of water used to obtain a perfect gauging, the more fireproof will be the mass, and less subject to dilation through the expansion of unnecessary water. In the case of the test pieces subjected to hard frost, the process of hardening has been stayed, and, although the proportion of water used was the same as in Experiment C, yet in the same period of time 20 per cent. less of the water had gone into combination, preventing the cement from attaining its normal strength.

## RAILWAY ORDERS.

(Continued from Page 432.)

Junction, P.Q., and the M.C.R.R. at P.C. ½ mile w. Charing Cross Station, between Lots 18 and 19, Con. 10, Raleigh, Ont.

8167 to 8171—September 23—Granting leave to the Manitoba Government Telephone System, to place its wires across the tracks of the C.N.R. and C.P.R. at various points in the Province of Manitoba.

8172—September 24—Authorizing the Corporation of the City of Toronto, Ont., to lay and thereafter maintain a section of high level intercepting sewer on the Don Esplanade, across the land and under the track of the G.T.R. in said city.

8173—September 24—Authorizing the Corporation of the town of Walkerville, Ont., to lay sewer under track of the G.T.R., Walkerville, Ont.

8174—September 25—Authorizing the C.P.R. to construct, maintain, and operate a line connecting the Pembina branch of its line with main line of the G.T.P. in the City of Winnipeg, Man.

8175—September 24—Amending Order of the Board No. 8087, dated September 15th, 1909, authorizing the Mt. McKay & Kakabeka Falls Railway to cross the track of the C.N.R. at Yonge Street, Fort William, Ont., by striking out the words "Applicant Company's" in the 3rd and 4th line of par. 3 and substitute the words "The Canadian Northern Railway Company's"; and the words "the Applicant Company's" in line 5 of said paragraph and substitute the words "the Canadian Northern Railway Company."

8176—September 24—Granting leave to the C.N.R. Company to cross with its line the tracks of the C.P.R., Wetaskiwin branch, at Camrose, Alta.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Oct. 7 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Oct. 7 '08 | Price Sept. 30 '09 | Price Oct. 7 '09 | Sales Week End'd Oct 7 | Price Oct 8 08 | Price Sept. 30 09 | Price Oct 7 '09 | Sale Week End'd Oct 7 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,175,000 | 1,799,000 | 175 | 186¼ | 186¾ | 187½ | 1227 | 174 | 174¼ | 186¼ |
| Canadian Northern Railway | 2,986.9 | | | 298,200 | 246,400 | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 902,777 | 817,362 | | | *1st. pref. 108½, 3rd pref. 67½, ordinary 23½ | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | 35,966 | 19,530 | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 78,416 | 70,070 | | | | | 188 | 187 | 214 | 214 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,515 | 68,657 | | 126½ | 126 | 124 | 80 | 101½ | 101¼ | 126 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 162 | 161 | 187½ | 187½ | 53 | | 162½ | 187½ |

| NAME OF COMPANY | MONTREAL | | | |
|---|---|---|---|---|
| | Price Oct. 7 '09 | Sale Week End'd Oct 7 | | |
| Canadian Pacific Railway | 186 | 186¼ | 6772 | |
| Canadian Northern Railway | | | | |
| *Grand Trunk Railway | | | | |
| T. & N. O. | | | | |
| Montreal Street Railway | 214 | 214¼ | 211½ | 1123 |
| Toronto Street Railway | 126 | 124½ | 123½ | 191 |
| Winnipeg Electric | 187½ | 187¼ | 187¼ | 120 |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## CANADIAN RAILWAY EARNINGS FOR SEPTEMBER.

Over and over again the big railways of Canada have broken their records of gross earnings. In nine months of 1909, the Canadian Pacific has made as much as it did during the whole of 1906, while its gross earnings from January 1st to September 30th, this year, show an increase of eight and a half millions when compared with returns for the same period last year. If present conditions continue, the gross earnings of Canada's biggest road will total over eighty millions when the end of December is reached. Thirty millions were earned by this road in 1901. In 1906 the figures had increased a hundred per cent.

Perhaps there is no other country in the world that can show a record so wonderful; and the gain is practically certain to continue.

Returns for the past [illegible] months are given below:

| | Sept. 1909 | Aug., 1908 | Increase or Decrease |
|---|---|---|---|
| C. P. R. | $8,148,000 | $7,152,000 | + $996,000 |
| G. T. R. | 3,959,004 | 3,789,948 | + 169,056 |
| C. N. R. | 1,076,000 | 807,100 | + 268,900 |
| T. & N. O. | 153,217 | 147,983 | + 5,234 |
| Montreal Street | 307,489 | 312,678 | — 5,189 |
| Toronto Street | 379,581 | 300,887 | + 78,694 |
| London Street | 24,645 | 21,806 | + 2,839 |

In the accompanying table are given figures for September, as well as returns from January 1st to September 30th, with comparisons. It will be noticed that increases are general. The figures which relate to the Grand Trunk and Canadian Northern systems are encouraging, while those for the electric street railways tell a most interesting story.

| Company | Sept. 1909 | Sept. 1908 | Increase | January 1 to Sept. 30, '09 | January 1 to Sept. 30, '08 | Increase |
|---|---|---|---|---|---|---|
| Canadian Pacific Railway | $8,148,000 | $6,317,000 | $1,831,000 | $57,272,860 | $48,781,000 | $8,491,860 |
| Grand Trunk Railway | 3,959,004 | 3,534,830 | 424,174 | 29,480,080 | 28,163,784 | 1,316,296 |
| Canadian Northern Railway | 1,076,000 | 911,700 | 164,300 | 6,770,400 | 6,100,100 | 670,300 |
| Toronto & Northern Ontario | 153,217 | 81,684 | 71,533 | 1,082,856 | 597,966 | 484,890 |
| Montreal Street | 307,489 | 292,218 | 15,271 | 2,641,027 | 2,496,554 | 145,373 |
| Toronto Street | 379,581 | 353,695 | 25,886 | 2,729,536 | 2,520,874 | 208,662 |
| London Street | 24,645 | 23,377 | 1,267 | 179,100 | 175,165 | 3,943 |

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.

## LONDON STREET RAILWAY.

President, H. A. Everett.
Manager, C. B. King.
Chief Engineer, H. Welburn.
Purchasing Agent, Geo. H. Bentson, Sec.Treas.

**Kind of Road:** Urban Street Railway.

**Length of Road:**

Double track, miles, 6.79.
Single track, miles, 26.46.
Total in single miles, 33.25.

**Character of Service:**

Car equipment No., 34 single truck closed cars; 5 double truck closed cars; 5 double truck open cars; 4 single truck open cars.
Number of motors, 116; power of motors, approx. 40 h.p.
Method of controlling, series-parallel.
Method of braking, hand.
Gauge of tracks, 4 ft. 8½ in.
Weight of rails, 60 lbs. to 73 lbs.

**Power:**

Direct current, D.C.
Voltage of transmission, 550 volts.
Trolley voltage, 550 volts.
Current collecting devices, trolley.

## CALGARY STREET RAILWAY.

### Earnings for September.

Returns received from Calgary's municipally owned street railway are much greater than was expected by even the most optimistic. Receipts for September amounted to $10,179, and for Wednesday, September 29th, the receipts amounted to $419. At this rate Calgary will receive a very large return from its street railway.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

QUEBEC.—Tenders will be received until Friday, October 22nd, for the construction of an Ice Breaker at St. Liguori, Montcalm County, Que. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

MONTREAL.—Tenders will be received until Monday, October 18th, for a site and the erection thereon of a public bath. Asselon and Perron, architects. L. O. David, city clerk.

MONTREAL.—Tenders for heating apparatus, Postal Station "D," Point St. Charles, Montreal, will be received until Wednesday, October 20th. Mr. C. Desjardins, Clerk of Works, P.O., Montreal. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

MONTREAL.—Tenders are being called by the Saraguay Electric & Water Company for turbo-generators of 2,000 K.W. capacity. Proportionate increase of power-house boilers and other equipment will be made likewise. Charles Brandeis, consulting engineer, 4 Phillips Place.

RIMOUSKI.—Tenders will be received until Monday, October 25th, for the construction of an Armoury at Rimouski. Plans, specifications, etc., can be seen at the office of the District Engineer, Mr. A. R. Decary, Quebec. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

**Ontario.**

ALLISTON.—Tenders will be received up to Monday, October 18, for boring for water at Alliston. Tenderers to state separate price for each hundred feet up to 1,000 feet, and separate price to be quoted for 5-inch and 6-inch pipe. J. H. Mitchell, chairman.

BERLIN.—Tenders will be received until Thursday, October 28th, for paving King Street. A. H. Millar, town clerk; Wm. Mahlon Davis, C. E., town engineer. (Advertisement in the Canadian Engineer.)

LONDON.—Tenders will be received until Monday, October 18th, for 18-inch cast iron water mains. John M. Moore, Engineer and Superintendent Waterworks. (Advertised in the Canadian Engineer.)

OTTAWA.—Tenders will be received until noon on Tuesday, the 19th October, for timber which the Indians of Cape Croker intend to take out during the ensuing winter, and deliver on the shore of Lake Huron, at convenient points for shipment, viz.:—500,000 feet B.M., comprising maple, basswood, elm, beech, hemlock, cedar. Further information can be obtained from Mr. John McIver, Indian Agent, McIver P.O., Ont., or from J. D. McLean, Secretary. Department of Indian affairs, Ottawa.

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until October 20th, for grading, etc., in connection with a spur line, 3,400 feet long. A. J. McGee, Secretary-Treasurer, Toronto and Northern Ontario, 25 Toronto Street, Toronto. (Advertised in the Canadian Engineer.)

LATCHFORD.—Tenders will be received until Thursday, October 28, for the construction of a Dam and Sluiceways across the Montreal River at Latchford. Plans and specifications can be seen at the office of J. G. Sing, district engineer, Confederation Life Building, Toronto, and on application to the Postmaster at Latchford. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**Manitoba.**

WINNIPEG.—Tenders will shortly be invited for the new 26-foot Louise bridge which is to be erected at an estimated cost of $120,000, including additions to piers. Col. Ruttan, city engineer.

WINNIPEG.—Tenders for supply of five only 18 inch valves for the domestic waterworks system, will be received up to Wednesday, October 20th. M. Peterson, Secretary, Board of Control.

**British Columbia.**

VICTORIA. — Tenders will be received up to 4 p.m., Monday, 15th November, for supplying 20 tons of best blue pig lead. W. W. Northcott, purchasing agent.

VANCOUVER.—Tenders will be received until October 25th for building a large bridge over False Creek, this city. sulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

## CONTRACTS AWARDED.

**Quebec.**

VERDUN.—This municipality awarded the following contracts last week:—Sewer pump; The Gould Pump Company, of Montreal, $2,830, the lowest tender. Two engines for electric installation, Belliss & Morcom, Birmingham, Eng., whose agents are Messrs Laurie and Lamb, Montreal, $9,500. Two 235 K.V.A., 3-phase engine type generators with direct connected exciters and complete switch-boards, the Canadian Westinghouse Company, $7,532. Mr. Charles Brandeis, of Montreal, was consulting engineer.

**Ontario.**

HAMILTON.—Amongst many others, the Smart-Turner Machine Company recently received the following orders:—The Fowlers Canadian Company, Hamilton, a duplex pump. The Adams Wagon Company, a duplex pump. The Temiscaming and Northern Ontario Railway, North Bay, a duplex boiler feed pump. The Burlington Canning Company, Burlington, a duplex pump.

TORONTO.—The tender of the Jenks' Dresser Company, of Sarnia, Ont., for the steel work of the new Parkdale School, $2,880, was accepted.

TORONTO.—In response to a recent invitation the City of Toronto received the following tenders for the superstructure of the Wilton Ave. bridge, whose dimensions were given on page 42 of the Canadian Engineer for September 10th: $35,809, $45,645, $48,200, $51,725, $54,500, £9,375, £13,330. The two latter were sent from Darlington, England, and Glasgow, Scotland.

TORONTO.—The following tenders were received by Mr. Frank Barber, York County Engineer, for the construction of a sewer on Parlwood Avenue:—

| | |
|---|---|
| Canadian Contracts | $4,996.68 |
| John Maguire | 4,998.00 |
| Excelsior Constructing & Paving Co. | 4,337.00 |
| J. H. McKnight Construction Co. | 4,010.00 |
| John F. Connolly | 3,978.00 |

The work was let to John F. Connolly.

**Manitoba.**

WINNIPEG.—The Board of Control have recommended the tender of W. Beverly Robinson, of Montreal, agent for the Stanton Iron Works, Nottingham, Eng., for the supply of cast iron pipes for water mains aggregating 1,128 tons. The figures are about $30,000, being considerably lower than any of the others received.

WINNIPEG.—Among many large contracts for structural material for buildings and bridges in the Western Canadian Provinces secured during September by the Manitoba Bridge and Iron Works, Limited, of Winnipeg, are the following:—Y.M.C.A. new building at Nelson, B.C.; new brewery for Lethbridge Brewing and Malting Company, Lethbridge, Alta.; Victoria Avenue Methodist Church, Brandon, Man.; public school, Watrous, Sask.; warehouse for Gordon, Ironsides & Fares, Saskatoon, Sask.; King Edward Hotel, Fernie, B.C., ornamental iron work; Burns building, Lethbridge, ornamental iron work; warehouse, Calgary, J. McNeil, contractor; highway bridge, Indian Head, Sask.; transmission installations for forty-two elevators, (line).

**Saskatchewan.**

LASHBURN.—The Canadian General Electric Company have secured contract for one Chloride Accumulator of 60 E-9 cells from Canadian Fairbanks, Limited, Winnipeg, together with controlling apparatus for operating one hundred 25 Watt Tungsten Lamps for five hours.

**Alberta**

CALGARY.—The contract for the general work at the Calgary Power and Transmission station, has been awarded to the Walker-Fyshe Company, of Montreal. Smith, Kerry & Chace, Engineers.

**British Columbia.**

VANCOUVER.—The contract for 55 D-7 cells of chloride accumulator with charging and controlling apparatus has been awarded to the Canadian General Electric Company. The battery will have a momentary discharge of 120 amperes, and will be used for operating and controlling high tension switches at the power-house of the British Columbia Electric Railway.

VICTORIA.—The new road roller recently purchased from the Waterous Engine Works of Brantford, Ontario, for $3,300 arrived a few days ago, and is giving satisfaction.

## RAILWAYS—STEAM AND ELECTRIC.

**New Brunswick**

ST. JOHN.—The accounts of the Transcontinental Railway show that there has been expended in the New Brunswick section a sum of $7,655,045.01. This was divided among the six sections of the work as shown in the table below. Returns for the work done during the month of Sept. were just completed recently. Ninety per cent. of all the ballasting to be done in the province has already been completed. The foundation has been about completed for the huge bridge at Upper Salmon River, which is to be the largest structure of its kind on the entire system, but no steel will be put up until spring.

During the month of September there was expended:

| | |
|---|---|
| Contract No. 1 | $ 91,112.92 |
| " " 2 | 17,311.24 |
| " " 3 | 68,050.06 |
| " " 4 | —6,879.81 |
| " " 5 | 112,895.79 |
| " " 6 | 69,834.84 |
| Total | $476,084.66 |

Total Expenditure

| | |
|---|---|
| Contract No. 1 | $1,376,792.66 |
| " " 2 | 301,623.02 |
| " " 3 | 712,154.97 |
| " " 4 | 1,419,708.47 |
| " " 5 | 2,103,414.02 |
| " " 6 | 1,739,351.87 |
| Total | $7,653,045.01 |

**Ontario.**

PORT ARTHUR.—That more cars are required for the street railway here is recognized by the railway board of the city council, and the question of ordering more cars is now being considered.

OTTAWA.—The Erie, London & Tillsonburg Railway Company has given notice of application to Parliament for a bill extending the time within which it may construct its authorized lines of railway. The Richelieu & Ontario Navigation Company is applying for amendments to its charter to allow an increase in capital stock, to construct terminals, and to secure the control of other similar companies..

PORT COLBORNE.—Everything has been arranged for the extension of the N. S. & T. R. trolley line from Welland to Port Colborne, and work was virtually started on October 5th. Six carloads of rails are on the way from Sydney. The contract has practically been let for the construction of a lift bridge over the feeder, and unless there is some delay at that point, the line will be completed by the first of the year.

**Manitoba.**

BRANDON.—The C.N.R. is to spend $10,000 improving the yards at this point, and has nearly completed the new freight sheds at a cost of $10,000.

HUDSON BAY JUNCTION.—The C.N.R. have a gang of men here erecting a large water tank, and immediately it is completed they will begin the erection of a roundhouse with stalls for eight engines; also a gang is putting in the necessary sidings for a railway yard.

WINNIPEG.—The Railway Commission in session here on Monday, October 11th, decided to order the C.N.R. to build a railway on Pembina Street. The work is to commence on November 1st, and proceed continuously.

WINNIPEG.—The Soo line will meet the new route of the C.N.R. to Duluth by a cut off via Thief River Falls, and is rushing work upon that branch. This week it was announced that ninety miles of steel will be laid this fall between Moose and Leech Lakes, Minn., and completion may be expected early next summer.

WINNIPEG.—The new main line of the C.P.R. to Northern Alberta, which will connect Winnipeg with Edmonton, will be completed this week. It will tap the C. & E. road at Wetaskiwin and is generally known as the Wetaskiwin branch. There remains but sixteen miles of steel to lay, and the last spike will be driven before Saturday night next. It will give practically another main line through to the Alberta capital via Portage la Prairie, Saskatoon and Yorkton.

WINNIPEG.—Tuesday, October 12, saw the last spike driven in the Winnipeg-Fort William section of the National Transcontinental Railway, which now stretches from Fort William to Edmonton, about 1,500 miles. The contract price, exclusive of station houses, was about thirteen million dollars. Since May 1906, when the work was started on what is known as section "F," the construction of the road has been carried out speedily. Difficulties of building the line through a rocky country, intersected by lakes and other obstacles have been surmounted in a masterful fashion. Several surveys had to be run in order to determine the best route, and parties worked their way through the wilderness both summer and winter. Then the right-of-way was cut out, after which followed the tremendous undertaking of removing the 5,000,000 to 6,000,000 cubic yards of solid rock, not to mention other material. The 244 miles of line from Winnipeg to Superior Junction was one of the most difficult sections on the whole line from coast to coast. Since the inception of the work there have been from 6,000 to 8,000 men employed continuously. The distance completed of the line to Lake Superior is 449 miles, and of this 200 miles compose the G.T.P. branch from Superior Junction to the lake. This was started in 1905, and finished in January last. Grades on the completed line are lower than those of any other line to the head of the lakes. These are four-tenth of one per cent

for the grain haul, and five-tenths against it. Along the line are thirteen bridges, and of these eight are of steel construction.

**Saskatchewan.**

CARLYLE.—Steel laying on the Maryfield-Lethbridge C.N.R. is progressing favorably, and is expected to be as far as here within ten days.

## LIGHT, HEAT, AND POWER

**Quebec.**

MONTREAL.—The Parish of Pointe aux Trembles have awarded to the Saraguay Electric & Water Company an exclusive franchise for electric light and power. The territory covers about 35 square miles on the Island of Montreal, stretching from Boure de Isle to Longue Pointe.

**Ontario.**

TORONTO.—A considerable amount of practical work towards deciding upon the standardisation of the equipment of the various municipalities in connection with the hydro-electric power scheme was accomplished at a conference of municipal engineers held at the City Hall, Toronto, October 13th. Mr. R. A. Ross, presided, and the municipalities represented were Stratford, Guelph, Berlin, Hepner, Woodstock, St. Mary's, London and Galt. It was decided that no motor exceeding ten horse-power should be supplied with power from lighting lines.

OWEN SOUND. A proposition made by The Georgian Bay Power Company for the town's power supply is being considered by the council. The company offers to sell 1,500 h. p. at $20, at Eugenia Falls, where it is developed, or $24 per h. p. delivered in town.

KINGSTON.—Mr. E. B. Merrill of Toronto, Ont., has completed in a most satisfactory manner his contract here in connection with the leaky gas tank. The work was very difficult and under the first test the work showed up 200 per cent. better than the contract called for.

## SEWERAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—Dr. Henri St. George, City Bacteriologist, has completed his report in regard to the condition of the city's water, showing it to be unfit for drinking.

VERDUN.—Verdun's bill of health has been appreciably cleaner since a water filtration plant was operated by the town, and the latest official returns state that not one single case of infectious disease has been notified during the past month. This fact has been referred to the City Health Committee as an argument in support of a filtration plant for Montreal.

**Ontario.**

ST. THOMAS.—The construction of a new sewer on several streets and the enlargement of the 8-inch mains on other streets have been recommended by the city engineer, Mr. Jas. A. Bell.

LONDON.—The council of the Village of Exeter have adopted the report and plans prepared by Mr. F. W. Farncomb, C. E., of London, for a system of waterworks which for the present will be for fire service only. The estimated cost, including concrete dam now under construction, is $25,000. This will include a pumping plant with a capacity of half a million gallons a day, a main along Main Street, with provision for future extensions, and an elevated storage tank, 125 feet high, with sufficient capacity for two days' supply for the town. The pumping plant will be so situated that an ample supply of spring water can be collected by gravity, if required, and pumped into the mains. The present supply will be drawn from the river.

**Saskatchewan.**

REGINA.—The city council have decided to make a big cut in the water rates to manufacturers. Hitherto the rate charged to large consumers has been 12½ cents per thousand gallons. The proposed new rate is 6 cents.

CARLYLE.—The installation of a waterworks system at a cost of $17,500 is being considered by this municipality. J. L. White & Company, of Sioux Falls, S.D., have outlined plans.

## TELEPHONY.

**Quebec.**

MONTREAL.—On Monday next, the C. P. R. will have in operation a telephone wire from Cartier, in Ontario, to Brandon, in Manitoba, a distance of 1,045 miles. This is the nucleus of a system which will stretch from the Atlantic to the Pacific with telephones along the company's branches. For the time being this wire from Cartier to Brandon will be used for emergency purposes only, but it is possible the company will utilize it for despatching trains before long. Every station and section house between Cartier and Brandon is a telephone exchange, and, in addition, each train will be fitted with apparatus which will enable the conductor to obtain connection with the nearest town from any point along the line in the event of an accident. This system will prove invaluable in calling assistance. The company is also installing a similar wire between Swift Current and Medicine Hat, and it is expected this section will be linked up with the line now completed before the end of the year.

**Saskatchewan.**

REGINA.—In the latest issue of the government Gazette, notice is given of the incorporation of the Glen Ewen Rural Phone Company, Glen Ewen, Saskatchewan.

## FINANCING PUBLIC WORKS.

**Ontario.**

BRIDGEBURG.—The ratepayers of this village passed a sewerage by-law on October 11th by a majority of twenty-nine. The plan is to provide two trunk sewers and a submain trunk sewer along three of the most available streets, into which various other sewers can be emptied.

**Quebec.**

MONTREAL.—Voting on the Montreal & Southern Counties Railway by-law on Saturday, at Montreal South, resulted in the by-law being carried by an overwhelming majority. The expected opposition did not materialize. Work on the new electric line will be started at once.

## CURRENT NEWS.

**Quebec.**

MONTREAL.—Notice is given in the Canada Gazette, for October 9th, of the incorporation of The Duckworth Boyer Engineering and Inspection Co., to inspect all kinds of material and machinery in connection with railways, bridges, piers and other structures and to act as experts generally in all matters requiring special knowledge and skill in the line of civil or any other branch of engineering. Walter Duckworth, engineer, of Lachine, Aurélien Boyer, engineer, and Stephen Newton, civil engineer, of Montreal, are interested.

MONTREAL.—A meeting of the purchasing agents of eight railway companies was held at the Place Viger Hotel last week. The gathering was entirely informal, it was stated and its object was to talk over the prices of ties, telegraph poles and other railway supplies. Among those attending the meeting were Messrs. Thomas Walklate of the Canadian Pacific and W. Cuthbert of the Grand Trunk.

**Ontario.**

OTTAWA.—The Board of Railway Commissioners recently left for the West. They will sit at the following places:—Prince Albert, October 18; Edmonton, October 20; Calgary, October 22; Vancouver, October 27, and Victoria October 29. Sittings in Nelson will be arranged later.

**Saskatchewan**

PRINCE ALBERT.—George E. Parkinson, who has been prospecting about a year, recently discovered within the limits of the city an oil belt from which streams continually flow. G. A. Charlton, analyst, Regina, states that the sample, taken from outcroppings containing considerable water includes one per cent. of thick, brown, crude oil.

**Foreign**

SCRANTON, PA.—Mr. F. W. Dean, mill engineer and architect, Boston, is regularly inspecting two large pumping engines now being built at the Scranton works of the Allis-Chalmers Co. Each engine is to have a capacity of 100,000,000 gallons each 24 hours and is of the triple expansion type with three horizontal cylinders with a vertical shaft. The centrifugal pump is below the engine.

BUFFALO, N. Y.—The Pierce Arrow Motor Car Co., having sold its output for the year 1910, is using every endeavor to increase its manufacturing facilities. For this purpose it has placed with The Aberthaw Construction Co., Boston, Mass., a rush order for a storage building, 300 feet long by 60 feet wide, four stories, along with a sawtooth addition to their manufacturing building and a covered passageway connecting the storage building with the body building. The builders are under contract to deliver this building in short order and are accordingly sending a large equipment of plant to Buffalo.

## PERSONAL NOTES.

MR. WILLIAM CARTER, of the Canadian Rand Co., has just returned to Toronto after a successful business trip through Western Canada.

MR. W. W. WALLACE, of Kemptville, Ont., has been appointed resident engineer on the third residency east of Toronto on the C.N.R. Toronto-Ottawa line.

MR. HERBERT W. KENT, of Vancouver, B.C., has been appointed sales agent for British Columbia, for Jens Orten-Böving & Company, hydraulic engineers, of London, England.

MR. J. S. WILLIS, of London, Ont., who has accepted the position of assistant engineer, under Mr. J. A. Bell, St. Thomas, Ontario, has taken charge of work at the sewage disposal plant.

MR. ALLAN PURVIS, superintendent of the Canadian Pacific Railway in Kootenay, has been appointed superintendent of the Chilliwack branch of the British Columbia Electric Railway.

MR. G. G. GRUNDY, general superintendent of the Temiscouata Railway, at Sherbrooke, Que., will shortly succeed Mr. D. B. Lindsay, who retires his position as general manager, retaining the office of secretary.

STEPHEN E. BASTOW of Bruce Peebles & Co., Ltd., Edinburgh, Scotland, passed through Toronto this week on his way to Vancouver, whence he will sail for Australia and South Africa. Mr. Bastow is on a business trip and reports a most satisfactory demand for the electrical machinery manufactured by his company.

MR. W. N. DIETRICH, who for several years had charge of the installation, maintenance and operation of electrical equipment and mechanical apparatus on the Canadian Pacific Railway, has opened offices at 16 St. Sacrament Street, Montreal, Que., where he will undertake any kind of electrical or mechanical work.

MR. LOUIS LAVOIE, formerly of Rimouski, and for the past few years a most efficient member of the Intercolonial staff, has been appointed purchasing agent of the Intercolonial Railway, with headquarters at Ottawa. He was for a time chief clerk in the General Superintendent's office, and later was on the personal staff of Gen. Man. Pottinger. Although only about thirty years of age, he has worked his way up through the various departments of the road, and is considered by the board of management to be the very best available man for the position.

## MISCELLANEOUS.

Debentures have been sold by the following municipalities. **Preston, Ont.**—$32,000. **Brussels, Ont.**—$15,000, for telephone construction. **Hull, Que.**—$115,000, for civic improvements. **Cartierville, Que.**—$5,000.

**Nova Scotia.**

HALIFAX.—City Engineer Doane recently prepared a report on the possibility of an underground system for the fire alarm wires, together with an estimate of the cost of installation, which was in the neighbourhood of $900.

**Ontario**

OTTAWA.—Two by-laws—one for improvements to the city hall, $60,000, and one for a new incinerator—may be submitted to the ratepayers of Ottawa in November.

GUELPH.—The ratepayers will vote on a by-law to raise $25,000 for the building of a new school.

WELLAND.—The ratepayers defeated the paving by-law. The issue will come up again in January.

GALT.—The ratepayers will vote on a by-law to raise $5,000 by the issuance of 4½% waterworks debentures.

PORT ARTHUR.—The ratepayers passed the 8 by-laws for local improvements and the giving of a site to the Port Arthur Steel and Wagon Works was also sanctioned. The granting of the franchise to the gas company was voted down.

TORONTO.—A survey is being made for a new road from Elk Lake to Charlton. About 11 miles of the road from Elk Lake to Gow Ganda have been completed, and 250 men are constructing the remaining 16 miles.

**Manitoba.**

BRANDON—The ratepayers will vote on a by-law to raise $13,000, for the purpose of extending the Winter Fair Building.

**British Columbia.**

TRAIL.—A by-law authorizing the city to raise the sum of $25,000 to install a municipally-owned water system, has been passed.

REVELSTOKE.—A by-law for electric-light plant and extensions, will be submitted to the ratepayers here at an early date.

NANAIMO.—The by-laws for the waterworks loan and the Boston St. bridge carried. The sewerage by-law was defeated by four votes.

EBURNE.—The ratepayers of the municipality of Richmond, will shortly vote on a by-law to raise $275,000 for waterworks purposes.

VICTORIA.—Civic improvements of many kinds are being made by this city before the cold weather comes. Considerable new work, which includes pavements, roads, sewers, etc., involving many thousands of dollars, was ordered at a recent meeting of the council.

## MARKET CONDITIONS.

Montreal, October 14th, 1909.

There is a lull in the market for foundry iron, in the United States, but in steel making iron, both Bessemer and basic, the turn-over has been very heavy and prices are still on the up-grade. Nineteen dollars, per gross ton, Valley furnaces, is now being asked for standard grades of Bessemer, for delivery in 1911, and it is reported that two or three of the principal furnace interests have withdrawn from the market entirely, holding their product at $20 for next year. A liberal tonnage, however, is being turned over at about $18.50 for prompt shipment and $19 for next year. One cargo, at least, of Middlesboro iron has now reached the Atlantic Coast, and it is reported that three or four others are under contract and are expected to arrive shortly. This will have the effect of preventing any considerable advance in foundry iron at Atlantic Coast points, unless English iron shows a further upward tendency.

English prices are somewhat easier as a result of heavy selling on the part of speculative interests. Home demand continues to improve, and stocks in quantity going into store are less than at any time during the past eighteen months. Notwithstanding this, prices have eased off about 6d. from the high point. It is felt, however, that this is a healthy condition and will probably be a starting point for an advance which will carry prices higher than previously. This is more probable in view of the fact that Continental prices, especially German, are now tending upwards and a fair enquiry is being received by makers, for export trade.

Local business continues good, both for domestic and import iron. A heavy tonnage is being turned over and some of the largest consumers are covering for their requirements for fully nine months ahead, thus evidencing their belief that the market will show a further advance during the next year. Supplies, in the case of small foundries, are comparatively light, and such users will be compelled to purchase liberally from stock to keep their works operating during the winter months.

The market for finished and semi-finished products shows almost no change, although pig iron shows further advances in some lines, this week, as will be seen from the following list:

**Antimony.**—The market is steady at 8 to 8½c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mill

steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet, dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compel'ed to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for 1/4, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb; and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ¾ x 12-inch

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 400 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, October 14th, 1909.

The tone of the hardware and metals trade is better, and demand shows a distinct increase, shelf goods being perhaps most active. Iron pipe prices were advanced on 8th instant as per our list, both black and galvanized. This is a consequence of the advance of American prices previously. Sheets, whether galvanized or plain, are as yet unchanged, but an advance is likely, prices being below those of corresponding date in either 1907 or 1906, and makers are said to be months behind in orders.

Lumber is fairly active at steady prices, the demand being greatest from city buyers. Bricks move freely at former prices. The cement market is in a state of flux; retail dealers in Toronto are selling at $1.35 to $1.40 without bags in load lots delivered, while wholesale dealers hesitate to quote less than $1.35. Camp supplies, so far as meats and dairy produce go, are higher.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.** Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur. This has been the case since September 16th. There is a good deal moving and the likelihood felt that the merger is unlikely to boost prices beyond a living point, will probably cause the free movement to continue. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—gauge, $4.50; 20-gauge, $4.25; per 100 lbs. Demand very active.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—The expected advance has come; we now quote, black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—An improved request is noted lately, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10x16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots, 65 per cent. of list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Camme'-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

### CAMP SUPPLIES.

**Beans.**—Hand picked, $2.50 to $2.60; prime, $2.30 to $2.40; Rangoon, hand-picked, $1.80 to $1.90.

**Butter.**—Dairy prints, 21 to 22c.; creamery rolls, 25 to 26c.

**Canned Goods.**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 6 to 6½c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ½c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 25 to 26c. per dozen, in case lots.

**Lard.**—Scarce and higher. Tierces, 15½c.; tub, 15¾c.; pails, 16c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 75c. a bag.

**Pork.**—Market uncertain. Short cut, $27.50 per barrel; mess, $26, nominal; no stock here.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 14½ to 14¾c.; breakfast bacon, 17c.; backs (plain), 18 to 19c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, October 12th, 1909.

The volume of business in all lines of trade throughout Western Canada has increased very materially within the last few weeks. The crop movement is heavy, and money is coming back to the farmers in large quantities and consequently to the different dealers in all lines of trade.

The local market in all lines of builders' supplies, is still active, as the splendid weather that has prevailed in the West this season has enabled all contracts this season to be completed in record time, and much new work undertaken, that would not otherwise have been started. The builders and contractors have had an exceptionally good year. Prices remain steady in all the lines quoted; but there seems to be an uneasiness in the cement situation, as few of the dealers know where they are at in regard to prices. Cement conditions in the past year or two have been very unsatisfactory, and if the big mergers that have taken place will do anything to regulate the output and the prices, it will be welcomed by contractors and dealers, and also by manufacturers.

All the local iron works have had a splendid season, and have been worked to their full capacity to keep pace with the demand

Winnipeg quotations are as follows.

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4½c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

**Picks.**—Clay, $5 per dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

**Pipe.**—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

**Pitch.**—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c.; sisal, 10½c.

**Spikes.**—Basis as follows.—1¼ 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 100 lbs.

**Timber.**—Rough, 8 x 8 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Tool Steel.**—8½ to 15c. per pound.

**Wire.**—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 aguge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.

THE QUALITY OTHERS STRIVE TO EQUAL

"QUEEN'S HEAD" Galvanized Iron

But be sure you get it.

CANADA

John Lysaght, Ltd. Makers, Bristol

A. C. Leslie & Co. Ltd. Montreal

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# TENDERS CALLED FOR

## TURBINE PUMPS.

### EXTENSION OF TIME.

Tenders will be received by the City of Toronto, Canada, up till noon of Thursday, October 28th (changed from October 14th), for the following Turbine Pumps:—

| | | | | | | |
|---|---|---|---|---|---|---|
| 4—13½ | million | gallon | pumps. | 100 | pounds | pressure. |
| 2— 5 | " | " | " | 300 | " | " |
| 2—10 | " | " | " | 65 | " | " |
| 2—10 | " | " | " | 110 | " | " |
| 2— 6½ | " | " | " | 90 | " | " |
| 2— 6½ | " | " | " | 100 | " | " |
| 2— 1½ | " | " | " | 65 | " | " |
| 2— 1½ | " | " | " | 110 | " | " |

With valves, piping, bed plates, couplings, etc.

The lowest or any tender not necessarily accepted.

For specifications and form of tender apply to the City Engineer.

## ELECTRIC MOTORS.

### EXTENSION OF TIME.

Tenders will be received by the City of Toronto, Canada, up till noon of Thursday, October 28th (changed from October 14th), for the following Electric Motors:—

4—1500 H.P. Synchronous Motors.
2—1500 H.P. Induction Motors.
4— 500 H.P. Synchronous Motors.
4— 500 H.P. Induction Motors.
2— 225 H.P. Synchronous Motors.

With exciters, switchboards, connecting material, etc.

The lowest or any tender not necessarily accepted.

For specifications and form of tender apply to the City Engineer.

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The city of Toronto, Canada, will shortly call for tenders for pole line supplies, including poles, cross-arms, pins, braces, etc., etc.

For information apply Electrical Department, City Hall.

---

## SUPPLY OF PIPE.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on **Tuesday, November 16th, 1909,** for the supply of three thousand feet of rivetted steel pipe 60 inches in diameter, and five hundred feet of rivetted tapered steel pipe, also one thousand seven hundred and eighty-two lineal feet of 60 inch reinforced concrete pipe for the outfall sewer.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the City Engineer, Toronto.

The usual conditions relating to tendering as prescribed by city by law must be strictly complied with, or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

JOSEPH OLIVER (Mayor),
Chairman, Board of Control.

City Hall, Toronto, Oct. 1, 1909.

## CITY OF VANCOUVER

### Tenders for Bridge.

Bids addressed to the Mayor and Council of the City of Vancouver, British Columbia, Canada, for the building of a bridge over False Creek, in that city, between Bridge Street and Beatty Street, will be received up to 4 p.m., of October 25th, 1909.

The structure is to be about 3,375 feet long between abutments and is composed of a 264 ft. centre bearing, electrically operated, swing span, carried on concrete piers, which are to be sunk by the pneumatic process, and sixty-six deck plate girder spans varying from 35 to 80 ft. in length, and supported on steel bents resting on concrete pedestals of which sixty are to be placed on piles and fifty on earth. Approaches, each about 150 feet long, consist of concrete retaining walls and abutments with earth fill. The bridge carries two wooden sidewalks, each 6 feet wide, and a roadway 44 feet wide, paved with creosoted wood blocks on creosoted planks and ties. Two electric railway lines are at the centre of the roadway and the bridge will be lighted electrically.

Tenders will be received on the following basis:

1st.—For metal work and all other superstructure materials erected.

2nd.—For substructure complete.

Plans, specifications, and bidding papers will be on file in the City Engineer's office, at Vancouver, or may be obtained from Waddell & Harrington, Consulting Engineers, Kansas City, Missouri, by sending with request a guaranteed deposit check of twenty-five dollars ($25.00), which amount will be refunded if papers be returned in good order.

All tenders are to be sealed and marked on the outside, "Tenders for Cambie Street Bridge."

Each bidder must deposit with his tender, cash or a properly certified check for a sum equal to ten per cent (10%) of the aggregate amount of said tender, made payable to the Mayor of the City of Vancouver, as a guarantee that he will enter into contract if the work be awarded him. The city does not bind itself to accept the lowest or any tender.

Newspapers inserting this advertisement without authority, will not be paid for same.

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### THE LONDON WATERWORKS.

Sealed, whole or separate, tenders will be received at the waterworks office, addressed to O. Ellwood, secretary, up to 4 p.m., Monday, October 18th, for the furnishing of material and laying of eighteen-inch cast iron water mains.

Plans and specifications may be seen at the office of Moore, Henry, & Munro, Carling Block, London, Ont.

Lowest, or any tender not necessarily accepted.

WM. JONES, Chairman.
JOHN M. MOORE, Engineer and Supt.

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## TOWN OF BERLIN

### To Contractors.

Sealed tenders addressed to the undersigned will be received up to noon, Thursday, 28th October, 1909, for the construction of a paved roadway on King Street, between Water and Scott Streets. Tenders for vitrified brick, sheet asphalt, bitulithic and asphalt block will be considered. Plans and specifications may be seen and forms of tender obtained at the office of the Town Engineer.

The lowest or any tender not necessarily accepted.

A. H. MILLAR, Town Clerk.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, OCTOBER 22nd, 1909. No. 16



## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. JAMES, B.A. Sc.

**Business Manager**—JAMES J. SALMOND

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Everything affecting the editorial department should be directed to the Editor.

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TORONTO, CANADA, OCTOBER 22, 1909.

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## TREES ON THE HIGHWAY.

One cannot travel through the rural sections of Eastern Canada and not be impressed with the number of handsome trees along the highway. During the period between the cutting down of the forests and the growing of these roadside shade trees some sections of the East presented very bald and uninteresting landscapes, but that is changed now.

Canada is developing a characteristic landscape, scenery most beautiful in spring and autumn.

It is a pity though that some time and money was not spent on maintaining the shape of these avenues of trees and in removing the objectionable natural growths along the roadside. Many hillsides, ploughed by the heavy rains, might be protected and beautified by planting sumach and other wild growths.

The contrast of a well-kept lawn or farm with a neglected roadside does not leave a favorable impression; and surely the municipality should at least keep pace with the individual. Usually it should be the leader.

## CONCRETE UNDER CONSTANT VIBRATORY MOVEMENT.

Much has been written of concrete, its fireproofing quality, its adaptability, and its cheapness, stress in concrete, the allowable loading, and such like, have furnished texts for many articles and books, but concrete under repeated loads, the action of concrete under constant vibratory movements is not so well known, has not been so thoroughly investigated, nor written about.

Stone buildings have stood for ages beside wagon roads, but will concrete stand the vibratory motion, the repeated shocks caused by motor cars, motor drays, traction engines and the street cars of modern traffic?

This is a matter for the architect and structural engineer, and we are pleased to know that in some measure the question is being investigated.

What is the increased depreciation in concrete structures due to, repeated loading or vibratory motion?

## PROBLEMS IN STATICS.

Some of our readers say our articles are too technical, some say they are not technical enough. Some say there is not enough theory, and others that there is too much. This week we commence a series of articles that we hope will combine both theory and practice.

Mr. T. R. Loudon, B.A Sc., has consented to solve twenty-six problems that admit of easy solution by the methods adopted in statics. Those anxious to go more fully into the theory of the problems will find Mr.

Loudon's recently published book, Applied Statics, admirably suited to their need.

We expect this series of articles will interest the younger reader in technical literature, will give the recent graduate, who wishes to study, an opportunity to brush up his mathematics, and will provide an interesting and practical series of articles for all who deal with design.

## EDITORIAL NOTES.

A Business Science Convention will be held at the Convocation Hall, Toronto, Ont., October 25th and 26th. The questions to be discussed are of wide interest. Two addresses by Mr. A. F. Sheldon, president Sheldon School, Chicago, are the main feature.

* * * *

British Columbia is again the storm centre of an "Asiatic labor" discussion. The contractors on the G.T.P. Railway cannot see their way to pay a very high wage to their employees on the grade; therefore the supply of white labor is scarce and the work drags. When urged to hurry, the contractor asks to be permitted to employ Asiatic laborers. The British Columbia Government says No. And there the matter stands.

### SEPTEMBER LAKE LEVELS.

The United States Lake Survey reports the stages of the great lakes for the month of September, 1909, as follows:

| Lakes. | Ft. above tide-water, New York. |
|---|---|
| Superior | 602.39 |
| Michigan-Huron | 580.82 |
| Erie | 572.38 |
| Ontario | 246.28 |

Since last month, Lake Superior has fallen ¼ in., Lakes Michigan-Huron 2¾ in., Lake Erie 5 in., and Lake Ontario 6½ in.

During October, Lake Superior is likely to fall ¼ in., Lakes Michigan-Huron 2¾ in., Lake Erie 3 in., and Lake Ontario 4¼ in.

## SOCIETY NOTES.

### CANADIAN SOCIETY OF CIVIL ENGINEERS.

The results of the ballot for election to the Canadian Society of Civil Engineers which closed October 9th, 1909 have been announced.

**Honorary Member**

Collingwood Schreiber, C.M.G.

**Members**

Anderson, F., Ottawa, Ont.; Caughey, C. M., St. Catharines, Ont.; Conway, G. R. G., Monterrey, Mexico; Fay, F. H., Boston; Fox, C. B., Toronto; Harvey, J. B., Ottawa, Ont.; Volckman, G. W., Ottawa, Ont.

**Associate Members**

Alexander, H. A., Winnipeg, Man; Bourbonnais, A. O., St. Isidore, Que.; Brian, M. E., Windsor, Ont.; Charles, H. H., McGivney Junction, N. B.; Gahan, H. N., Vermillion Bay, Ont.; Harper, W. B., Nepigon, Ont.; Hollingworth, W., Toronto; Jermyn, P. V., Toronto; Kahn, G., Toronto; Lamoureux, J. A., Ottawa; Latornell, A. J., Edmonton, Alta.; Mellor, A. A., Montreal; McArthur, F., Yorkton, Sask.; Near, W. P., Toronto, Ont.; Riddall, J. B., Winnipeg; Robinson, L. H., Fort William, Ont.; Ryan, H. A., Chipman, N. B.; Silverton, F., Vancouver; Taylor, A., Portage la Prairie, Man.; Wass, S. B., Durham, Ont.; White, T. W., Winnipeg; Wimbles, A., Saskatoon.

**Associate**

Casgrain, C. P., Quebec.

**Transferred from the Class of Associate Member to that of Member**

Barton, D. S., Levis, P. Q.; Chapleau, S. J., Ottawa; Gzowski, C. S., jr., Vancouver, B. C.; Macdougall, G. D., Truro, N. S.; Moritz, C. J. H., Niagara Falls, N. Y.; St. Laurent, A., Ottawa; Waterous, C. A., Brantford.

**Transferred from the Class of Student to that of Associate Member**

Brown, F. B., Montreal; Burnett, A., Greenwood, B. C.; Clarke, F. F., Toronto, Ont.; Clark, G. T., Toronto; Congdon, J. H., Toronto; Davidson, W. A., Coleman, Alta.; Denis, V., Ottawa, Ont.; Devenish, W. R., White River, Ont.; Dick, J., Parry Sound, Ont.; Edwards, W. M., Calgary, Alta.; Elliott, L. B., Brooks Station, Alta.; Foreman, A. E., Vancouver, B. C.; Girouard, E. C., Dombourg, P. Q.; Girouard, R. A., La Tuque, P. Q.; Greig, A. R., Winnipeg, Man.; Grenon, J. F., Chicoutimi, Que.; Heaman, J. A., Winnipeg; Keith, F. S., Vancouver; Landy, A. P., Beaufort, N. B.; Lawrence, W. D., Montreal; LePage, J. S. S., Quebec; Livingston, D. A., Winnipeg, Man.; Livingston, D. C., Yzabal, Sonora, Mexico; MacGowan, A. R., Moncton, N. B.; McCuaig, G. E., Montreal; Melancon, H., Ottawa, Ont.; Menard, J. P., St. Eusebe, P. Q.; Millar, J. L., Pembroke, Ont.; Moore, H. H., Calgary, Alta.; Munn, D. W., Vancouver, B. C.; Newlands, J. E., Strathmore, Alta; Richards, C. C., Bankhead, Alta.; Ridley, E. N., Calgary, Alta.; Rogers, C. H., Peterborough, Ont.; Smith, S. G., Ottawa, Ont.; Steeves, C. M., St. John, N. B.; Taylor, R. F., Cobalt, Ont.; Thorne, S. M., Cobalt, Ont.; Whitley, H. A., Montreal; Wilson, J. L., Bridgewater, N. S.; Young, W. B., Winnipeg.

### ENGINEER'S CLUB OF TORONTO.

At the meeting of the club on October 14th, M. Dillion Mills occupied the chair. Professor Robert Angus, of the Faculty of Applied Science, Toronto University, gave an adress in which he described some of the better European science laboratories and large factories. In an early issue we expect to be able to give Mr. Angus' lecture in full.

### AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS —TORONTO BRANCH.

The annual meeting of the Toronto branch of the American Institute of Electrical Engineers was held in the rooms of the Engineers' Club of Toronto, on Friday evening, October 15th. An interesting paper on "Transmission Line Calculations" was read by Mr. A. J. Soper, of Messrs. Smith, Kerry & Chace, and a lengthy discussion in which Mr. E. M. Ashworth, Professor T. R. Rosebrough, Mr. H. W. Price, and others, took part, followed.

The election of officers for the current year resulted as follows: Chairman, Mr. H. W. Price, School of Practical Science; vice-chairman, Mr. E. Richards; executive committee, Messrs. A. L. Mudge, R. J. Clark, H. A. Moore, and F. A. Gaby. Mr. W. H. Eisenbeis, of the Canadian Westinghouse Company, is secretary.

The Toronto members of the society are looking forward to a number of good meetings during the coming winter, as several prominent engineers have signified their intention of presenting papers. The meeting was preceded by an informal luncheon, served at the St. Charles Cafe.

## REPORT OF THE MEETINGS OF MUNICIPAL ENGINEERS, HELD ON TUESDAY AND WEDNESDAY, OCTOBER 12th and 13th, 1909.

In accordance with the resolution passed at the first meeting held on September 29th, the engineers of the municipalities met on October 12th in Committee Room No. 1 of the Toronto City Hall.

The meeting was called to order at 2 p.m. and the municipalities were represented as follows: London, E. I. Sifton, Ald. Stewart; Woodstock, C. Archibald; St. Mary's, L. H. Reesor, W. R. Reynolds; Stratford, R. H. Myers, Mr. Barnett; Guelph, J. J. Hoig, E. Richards; Berlin, E. J. Philip; Hespeler, L. E. Weaver; Toronto, E. Richards; Galt, E. B. Merrill.

The interests of Waterloo were looked after by Mr. Philip, while St. Thomas, Preston, Ingersoll, and New Hamburg were represented by the Engineers of the Commission.

Mr. Ross, the Consulting Engineer of the Commission, was asked to take the chair.

### Secondary Voltages.

The first subject was that of secondary voltages for light and power. Final decision of this subject had been postponed from the former meeting to allow each engineer to study local conditions to determine whether he could comply with the proposed standard. A report on the subject by the Engineering Department of the Commission, may be summarized as follows: We would advocate the distribution of power at 13,200 volts (6,600 volts for Galt, Preston and Hespeler), the use of three-phase 13,200/575 volt transformers for power, and the use of 2,200/220-110 volt single phase transformers for lighting. Where a small power user wishes power from the lighting mains supply him with 220 volt single phase power using standard lighting transformers. Where a large power user wishes power and you cannot economically or advisedly reach him with your 13,200 volt circuits, sell 2,200 volt power and have him furnish not only motor but transformers, recommending the use of 2,200/575 volt transformers.

During the discussion it was found that London could use the 550 volt secondary, Woodstock could do so if the other municipalities took some of their present 25-cycle 2,200/220-110 volt transformers off their hands. It was also decided that 550 volt power could be made safe for all factory work.

The report was finally adopted with the following amendments:

It was considered inadvisable to run higher than a one horse-power single-phase motor on the lighting transformers.

It was considered inadvisable to run higher than a ten horse-power motor on the 2,200 volt lighting mains if the motor is to be on during lighting hours.

No limit in size is necessary if the motor is to operate only during restricted hours.

### Frequency.

The decision of the last meeting on this subject was confirmed, and it was decided that practice should tend towards 25-cycle power for all purposes.

### Single vs. Three-Phase Transformers.

This discussion, also postponed from last meeting for further data, was opened by reading the report of the Engineering Department. Their decision summarized was, all station transformers should be three-phase with two taps on the primary side, all power service transformers, three-phase 13,200 volts primary, 575 volts secondary, with two taps on the primary side, and all lighting service transformers to be single phase 2,200/220 110 volts. (Percentage of tap under subsequent heading.)

During the discussion the questions of weights and sizes as well as prices were considered, and it being found necessary to secure further data the subject was postponed to the following day.

### Taps on Transformers.

This discussion was opened by reading the opinion of the Engineering Department, which summarized was: We advise the use of two taps on the primary side only, arranged for normal voltage, 2½ per cent., 5 per cent. and 7½ per cent.

As these taps were for boosting only, the question of lowering taps was dismissed as unnecessary when Mr. Sothman advised that the normal voltage sent out from the Commission stations would always be as near 13,200 volts as the taps on their 110,000/13,200 volt transformers would allow. It was then decided that on the understanding that the Commission will furnish 13,200 volt power at their stations, that their recommendations regarding transformer taps be accepted, to apply to both stations and 13,200 volt power service transformers.

It was also decided that all 13,200 volt transformers be specified to have two coils so that they may be standard with the transformers for the 6,600 volt circuits.

### Feeder Regulators.

This subject was discussed for some time, advocates for and against the desirability of installing them from the start being strong in their opinions, and it was finally decided that the meeting should recommend that feeder regulators be installed on all lighting feeders but not for the power feeders, and if not installed at present that all arrangements be made for future use.

### High vs. Low Voltage Synchronous Motors.

The Engineering Department reported that on the small sizes which would be used by most of the municipalities, the cost of the high voltage motor would be more than the cost of a 2,200 volt motor with the cost of the increased size of transformers added. On the large sizes the high voltage motors would be cheaper. As Mr. Sothman had expressed a wish to discuss this question the subject was postponed.

The meeting then adjourned until 8 p.m. when the following was discussed:

### Single vs. Three-Phase Transformers.

Mr. Reynolds and Mr. Philip during the intermission had secured some data from a publication on the comparative weights of these transformers, which showed that in small sizes the weight of a three-phase transformer (without oil) was greater than three single-phase transformers, while the reverse was true if the weights of the oil were added. This caused general discussion, as it was contrary to the general belief that it was finally postponed until the next day, when it was hoped to have greater data to work on.

### Street Lighting.

This subject was opened by reading the report of the Engineering Department. Summarized this reports reads: The art of street lighting is in a transitory stage, due to the growing belief in small units closely spaced. The time since last meeting was too short to allow proper report being made up. Suggested that a committee be appointed to make up a

report and to invite experts from the manufacturing companies to offer recommendations at the next meeting.

A very interesting discussion resulted, which showed that the concensus of opinion favored incandescent lamps properly spaced, but the method of wiring and control was not determined. Finally the Engineering Department was asked to write the City Engineering Department of Boston for a copy of the report made by them covering the experiments and tests they conducted previous to accepting Tungsten and Magnetite lamps as their standard.

It was also decided to approve the report of the Engineering Department and appoint the committee suggested, leaving to the committee the arrangements for the trip, but requesting the report be made as soon as possible.

**High vs. Low Voltage Synchronous Motors.**

As Mr. Sothman was able to attend this session the subject was again brought up for final discussion, and it was finally decided that owing to the small sizes of motors needed, the fairly temporary use for these motors, the present state of the art of designing high voltage synchronous motors, and considering that for small sizes the low voltage sets are cheaper, be it resolved that the meeting recommend the use of the lower voltage units.

During this discussion the question of pump motors for London was taken up, and it was decided that synchronous motors should be used, and if separate power and light circuits are used from the Commission's station to the city station, the motors should be on the power circuit.

The meeting then adjourned.

Mr. Ross called the meeting to order at 9.10 a.m. on Wednesday, the same delegates being present with the exception of Alderman Stewart of London.

**13,200 Volt Insulators.**

The delegates gave their demands as follows: Berlin 1,000; Guelph 1,000; Woodstock 100; St. Mary's 350; and London 3,500. The number needed by Stratford, St. Thomas, and Preston would be secured. It was then resolved that the Commission secure quotations on 3,500, 7,500 and 13,000 f.o.b. some central point.

Under the same heading discussions were held on Cross Arms, Steel vs. Wood Pins, and Braces and Bolts.

Cross Arms.—Were considered to be too special to bulk orders, each municipality having special requirements as to length and spacing, but it was decided cross arms should be long leaf yellow pine and painted with two coats of good paint. Treated cross-arms not considered necessary.

Steel vs. Wood Pins.—This was settled in favor of a good wood pin. Mr. Sothman preferred an all steel pin, and asked to be placed on record; Mr. Ross voiced the sentiments of the other representatives, by deciding on wood pins for any voltage below 20,000 volts.

Braces and Bolts.—The Commission was asked to secure tenders on standard braces and through bolts.

**Auditing.**

Under this heading the Engineering Department presented copies of accounting systems and reports from the Public Service Commission of New York State, the Railroad Commission of Wisconsin, the Gas & Electric Light Commission of Massachusetts, and the Ontario Railway and Municipal Board.

These were considered, and then it was resolved that the towns authorize their auditors to meet and draw up a system of accounting to be submitted to a joint meeting as soon as possible.

**Rates for Incandescent Lighting.**

This discussion was opened by the discussion of lamp renewals. Berlin, Guelph and Woodstock furnish free renewals. It was considered advisable to furnish free renewals, but rates must be made to cover this. This began a discussion on rates. There were many variations of the Toronto plan considered, but they all amounted to some type of differential rate. The two plans considered best were to charge a monthly charge based on the number of rooms and a kw. hour rate, and, second, a fixed monthly charge based on the floor area of the house and a kw. hour rate. After a long discussion Messrs. Philip, Sifton and Archibald were appointed a committee to get an example of rates from all the municipalities and compare them, and compare estimated results of the various plans.

**Grounding of Neutrals.**

It was decided that all neutrals should be grounded.

**Single vs. Three-Phase Transformers.**

It was found that the manufacturing companies were not prepared to give full data on three-phase service and station transformers at the voltages required, so this question was postponed for discussion at the next meeting. Meanwhile any municipality desiring to expedite matters is to ask for tenders—and the Commission will secure general data on the subject.

**Next Meeting.**

It was decided that the next meeting was to be held at Preston, October 26th and 27th.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8218—October 1—Granting leave to the Manitoba Government Telephone System to place its wires across the track of the C.P.R. at Neepawa, Man.

8219—September 29—Authorizing the C.P.R. to construct industrial spur along the lane in block 10 and 16, and across 24th Street, City of Saskatoon, Sask.

8220—September 29—Authorizing the C.P.R. to construct bridge No. 6.7 on the Cascade Section of its line.

8221—September 30—Authorizing the C.P.R. to open for the carriage of traffic that portion of the double track of the Ontario and Quebec Railway, Smith Falls Section from St. Lazare to Dalhousie Mills.

8222—September 30—Authorizing the C.P.R. and G.T.R. to operate their trains across interlocker at Brampton, Ont.

8223—September 29—Authorizing the Corporation of the City of Toronto, Ont., to lay sewer on Howland Avenue under the tracks of the C.P.R. in said city.

8224—September 29—Granting leave to the Rural Municipality of Pipestone, Man., to place its wires across track of C.P.R. near Ewart, Man.

8225—September 30—Granting leave to the City of Winnipeg, Man., to construct for the purpose of a patrol road, suitable crossings where its right-of-way for its transmission power lines crosses the C.P.R.

8226—October 1—Authorizing the West Canadian Collieries, Ltd., to construct an overhead crossing across the C.P.R. at Bellevue, Alta.

8227—September 29—Authorizing the Arthabaska Water & Power Company of Victoriaville, P.Q., to lay water pipe under the tract of the G.T.R. Company about 1,000 feet west of Nicolet River Bridge, at Victoriaville, P.Q.

8228—October 5—Approving and sanctioning location of the Montreal & Southern Counties Railway Company from St. Denis Street, St. Lambert, to Chambly Road, Longueuil County, Chambly, P.Q.

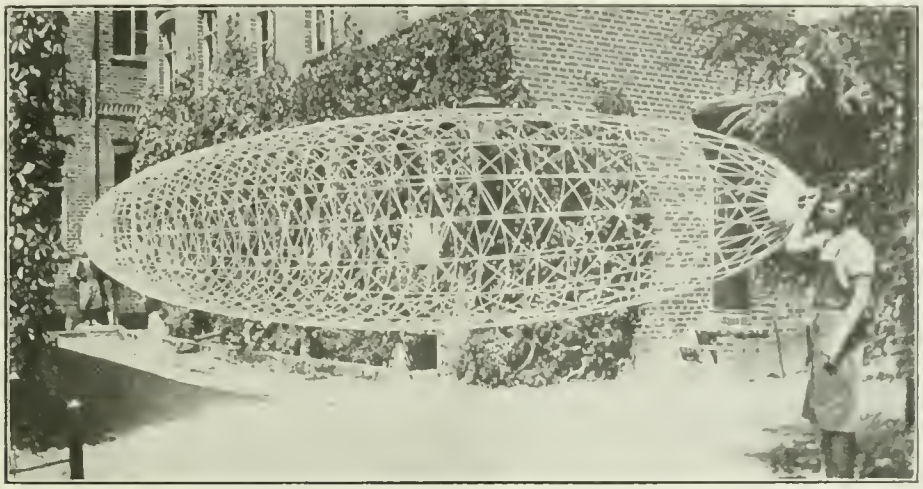
(Continued on Page 454.)

## ALUMINIUM TO BE DISCARDED FOR AIRSHIPS IN GERMANY.

On account of many mishaps with aluminium airships, a new type of airship frame is making its appearance in the German empire, which in this branch of aeronautics is admittedly leading. There went stirring news through the German daily papers some days ago to the effect that Count Zeppelin the first man in aeronautics intends to use no longer aluminium for his airships but some lighter material, among others wood. The idea came to him at last year's accident, when his Z II. exploded. He, himself, and experts, meditated what in all the world could have been the cause of the above catastrophe, and it is now certain that the immense mass of metal contained in the rigid skeleton and cars attracted atmospheric electricity and conducted sparks from the metal to the gas.

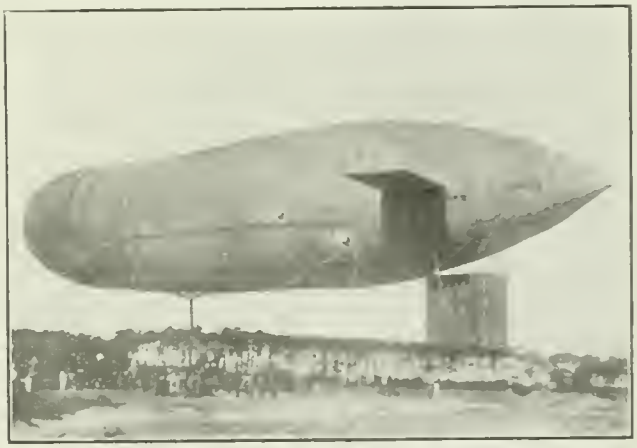
Models were built of wood and the best type is illustrated herewith. As can be seen, the whole has the shape of a spindle and thus offers less air resistance than the cylinder of the Zeppelins. We know that the bending moment is greatest in the middle and therefor here the diameter is largest. Such a shape will therefor resist bending forces much better than the cylinder of the Zeppelin ships. Another important feature is that wood can be repaired with few and simple tools and anywhere in villages or open field while a complicated aluminium skeleton requires special apparatus, tools and skilled mechanics which are available only in larger towns and this may prove fatal in the enemy's land, in a future war. Still there are other advantages of which the lighter weight is the principal one. The specific weight of Canadian pine employed here is 0.36 to 0.4, while that of aluminium is eight times as much. On the other hand this metal is three times as strong, anyway a stick of the same strength if of wood, is nearly one third the weight. Thus, these airships can be made much smaller and yet have the same lifting power. A Zeppelin has reached the smallest size, with 11,000 cubic meters, while the wooden balloons may be 6,500 cubic meters. The inventor, a Berlin architect, has calculated that the saving in weight on account of direct and indirect effect would be about 30 per cent. of the total weight of the Zeppelin balloon frame, which is 10,000 kilograms. In other words if wood was substituted he would obtain 3,300 kilograms more lifting power, and this could be utilized for more fuel or a larger motor or more passengers. The material if coated with weatherproof varnish is unsensitive against heat, cold and moistness, while aluminium and other metals oxidize. Owing to its own elasticity it also can withstand shocks much better. But the main feature is that it does not conduct electric currents and will be comparatively safe in a thunderstorm, while the aluminium balloon of Count Zeppelin was ignited by electric sparks in the thunderstorm at Echterdingen above referred to, which gave the motive for this invention.

The designer is the Berlin architect, Mr. Rettig, who was the chief builder of the German parliament, and won the first price of national monument. As he has also designed many racing boats and thousands of school benches he has



**Wooden Skeleton.**

**Wooden Skeleton—end view.**



**New Parseval over trial field of Aero-show.**

become an authority in wood. His model illustrated herewith has a length of twenty meters and a height of 2½ meters. It was sent to the international aero exposition at Frankfort this summer, where it was quite an attraction. Now, as airships in full size will be built after his system, but as said before, they are not as big as the Zeppelin, although their lifting power and engine is about the same. The meshes of this type are only 3 to 4 square meters in size, and the envelope being thus supported by a smaller frame can withstand a greater pressure than in the Zeppelins, where the meshes are 8 meters long and 3 wide. Consequently, if through the sunshine or other causes the inner pressure rises, the gas will remain in the balloon and tighten the cover instead of escaping like in the Zeppelin, where the large suspended surface does not permit a great gas pressure. Thus, such a balloon is capable of staying in the air much longer for there is no danger that the envelope will be torn if the gas expands in the sunshine, etc.

## RAILWAY ORDERS.

(Continued from Page 452.)

8229—October 5—Granting leave to the Montreal & Southern Counties Railway Company to place its wires for conveyance of electricity across the lands and track of the G.T.R at six different points in its yards at Point St. Charles, P.Q.

8230—October 5—Authorizing the Ontario Pipe Line Co. to lay gas pipes under the tracks of the T.H. & B. Railway, where the same crosses Victoria Avenue South, in the City of Hamilton, Ont.

8231—October 6—Approving of location of the G.T.P. through the City of Fort William, Ont., subject to the condition that the said railway shall do as little damage as possible, and shall make full compensation to all persons interested for all damage by them sustained by reason of the location of the said railway along any street in the said City of Fort William, Ont.

8232—October 6—Approving and sanctioning location of the G.T.P., Prince Rupert easterly, mileage 180.74 to mileage 235.675, coast Dist. B.C.

8233—October 4—Authorizing the C.P.R. to use and operate bridges at mileage 65.1, 84.4, and 106.1 on its Pacific Division, Thompson Section, between Kamloops and No. Bend.

8234—October 5—Approving and sanctioning revised location of station grounds of the G.T.P. on its Yorkton Branch from Sec. 4, Tp. 24, R. 5 to Sec. 6, Tp. 25, R. 4, west of the 2nd Mer. Dist. of Assiniboia, mileage 11 to 18.

8235—October 6—Recommending to the Governor-in-Council for sanction by-law passed at a meeting of the Board of Directors of the Michigan Central R.R. in the City of New York, on 22nd of September, 1909.

8236—October 5 — Authorizing the C.P.R. to open for traffic that portion of the Port Moody Diversion of the Cascade Sec. of its line of railway, from mileage 113.76 to 115.68.

8237—October 5—Granting leave to the C.P.R. to construct its railway across Main Street Village of Shoal Lake, Man.

8238—October 5—Temporarily approving tariff of tolls which the Bell Telephone Company shall be authorized to charge and agreement between the said company and eight other companies located in the Province of Ontario.

8239—September 25—Granting leave to the C.N.R. Co. to cross with its tracks the track of the G.T.P. at or near Riley, Alta.

8240 — October 4—Authorizing the C.P.R. to use and operate bridges on the Central Division, Broadview Section of its line of railway.

8241—October 4—Authorizing the C.P.R. to use and operate four bridges on the Shuswap Section, Pacific Division, of its line, between Revelstoke and Kamloops.

8242—October 7—Granting leave to the C.P.R. to construct its railway across thirteen highways, on its Sudbury-Kleinburg Branch.

8243—October 7—Approving and sanctioning location of the C.N.R. from mileage 72 to mileage 88, up the North Thompson River, from Kamloops, B.C.

8244 October 5—Authorizing the C.P.R. to construct, maintain, and operate spur for the Winnipeg Oil Company, Saskatoon, Sask.

8245—October 5—Authorizing the C.P.R. to construct, maintain, and operate industrial spur in Blocks 4 and 6 across 26th Street, Saskatoon, Sask.

8246—October 5—Authorizing the C.P.R. to construct, maintain, and operate spur to the property of the Kamloops Mines, Ltd., on Lot 43 Yale Dist., B.C.

8247—October 5—Authorizing the G.T.R. to construct proposed iron bridge to replace the present structure at farm crossing, at mile post 11.68 on the 17th Dist. of its line of railway west of St. Catharines, Ont.

8248—October 2—Authorizing the C.P.R. to construct, maintain and operate branch line, or siding, to and into the premises of Benjamin Moore & Company, Ltd., Toronto, Ont.

8249—October 7—Approving location and detail plans of the C.P.R. station at Redvers, Sask.

8250 to 8252—October 5—Authorizing the Corporation of the City of Peterborough, Ont., to lay and thereafter maintain water main under the track of the G.T.R. at Murray Street, McDonell Street, and Ware Street, in said city.

8253—October 5—Authorizing the Corporation of the City of Hamilton to lay and thereafter maintain water pipe under the track of the G.T.R. on Young Street, Hamilton, Ont.

8254 — October 5—Authorizing the City of Winnipeg, Man., to lay and thereafter maintain a sewer under the track of the C.P.R. where it intersects the crossing between Talbot and Carter Streets, Winnipeg, Man.

8255 and 8256—October 5—Granting leave to the Manitoba Government Telephones, to erect, place, and maintain its wires across the track of the C.P.R. 3½ miles south-west Hartney Station, Manitoba, and 2½ miles south of Selkirk, Man.

8257—October 12—Granting leave to the C.N.Q.R. to erect, place, and maintain its telgraph wires under the wires of the G.N.W. Telegraph Company near Cap Sante, P.Q.

8258—October 8—Authorizing the C.P.R. to construct bridge No. 75.1 on the Moose Jaw North-West Branch of its line of railway.

8259—October 5—Granting leave to the Rural Municipality of Miniota, Man., to erect, place, and maintain its wires across the track of the C.P.R. at P.C. one mile west of Arrow River Station, Man.

8260—October 5—Authorizing the Municipal Council of the Township of Harwich, County Kent, Ont., to construct a drain under the track of the Lk. E. & Detroit River Railway Company (P.M.R.R.) in the said township.

8261 to 8264—October 5—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across P.C. at the M.C.R.R. and P.M.R.R. Highgate, Ont., Montreal Terminal Railway at P.C. at Bout de l'Isle Park, P.Q., and the G.T.R. at Irondale, Hamilton, Ont., and at Notre Dame Street, St. Henry, Montreal, P.Q. (Westmount).

(Continued on Page 471.)

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## THE SANITARY ENGINEER OR THE PATENT VENDOR.

Wherein lies the wisdom of a municipality obtaining expert advice from the patent vendor?

Yet such is done every day. The business man comes along with a distribution of pamphlets and a vocabulary of ready-made science. His goods may or may not be the very best in the market. But, who shall judge? Shall the municipality judge? The people who are not in a position to compare the goods with any others in the market, just take for gospel all that the pamphlets have to say, pay the price and save the fees otherwise due, to the sanitary engineer for independent advice.

As soon as a consulting engineer has one dollar invested in a patent contrivance, he loses his birthright. He is no longer a consulting engineer, and has no right to ask to be consulted. He carries one thing in his waistcoat pocket only, the thing he has to sell. Who can blame him if he unduly praises it? This is his business. He is a salesman. If he sells a gilded bar of lead as solid gold, he is cute, this is business.

The consulting engineer should have the whole world market open to him. His choice should be unlimited and unbounded by proprietary interests. This is the advice he is paid for. His remuneration for advice is the only fee which can be due to him. Any other profit is the profit of the tradesman or salesman.

What can be said of the municipality, who, wishing to build a sewer, asks of the brick maker, his expert opinion, as to whether bricks or concrete will make the best sewer?

What can be said of the municipality who are content to elect the trading company for the installation of public works, as contractors and engineers combined?

Yet, these things are done. Lucky for the trading company that they are supreme to pass and certify as perfect their own work. Lucky for the municipality when they obtain the services of a trading company who condemn their own work when they know it to be imperfect, and thus play the rôle of perfect humanity.

There are no questions municipal which require greater variety of treatment, than the questions of sewerage, sewage disposal, water supply and water purification. There is no one defined system of sewage disposal or any one defined system of water purification which will fit all occasions and all local conditions. Every authority of standing in Europe and America has made this clear. Every consulting engineer recognizes this as the first outcome of his practical experience.

The main study of the consulting engineer is first to know his subject in all its aspects, and then, relative to local conditions, design and advise as to the best system to meet the particular conditions.

The prime study of the salesman and patent vendor, is only to know the details of his object of sale, and then force all local conditions to meet and fit into that object.

The consulting engineer is a man who should not only give the best of the maximum in engineering thought, but should also act as an auditor and check with reference to commercial fads, commercial exaggerations, commercial hustle and push which looks for the maximum efficiency in sales at the expense of the maximum efficiency in engineering results.

## SEWAGE DISPOSAL.

### Removal of Putrescibility.

Chapter VII.- Continued.

### Distributing Appliances.

In our last issue dealing with the question of fixed sprays as adopted at Columbus, Ohio; Hamilton, Ont.; Birmingham, Eng., etc., we quoted authorities from the States, and the Royal Sewage Commission, Britain, acknowledging that even and equal distribution was practically unattainable, and further, that much attention was required in keeping the nozzles clear.

Scott-Moncrieff in the Chadwick Lectures last year raises the question of danger to health by spraying sewage from nozzles. He says:—"I think it is most unfortunate that any sort of support should have ever been given by persons responsible for the public health to any kind of sewage distribution that involves the spraying of pathogenic organisms, especially when no provision is made to provide against the action of high winds in throwing them broadcast into the atmosphere. I have no hesitation in saying that spraying septic sewage will one day be the cause of an alarming epidemic outbreak, and that after many lives have been lost this system of distribution will be absolutely prohibited." This statement has led the Birmingham authorities to make a series of observations as to the bacteriological character of the air at and near the sewage works. It can be said, however, that up to the present men working on spray sewage beds have not abnormally suffered from zymotic disease.

Prof. Winslow in his recently published experiments, "The Sanitary Significance of Bacteria in the Air of Drains and Sewers;" states, "My tests of drain air, like those of Carnelly and Haldane, and Laws and Andrews on sewer air, indicate that mechanical splashing may produce a local infection of the air in immediate contact with the spray. Such an infection does not, however, extend for any distance or persist for more than a minute or so."

It does not appear that there are good grounds for so

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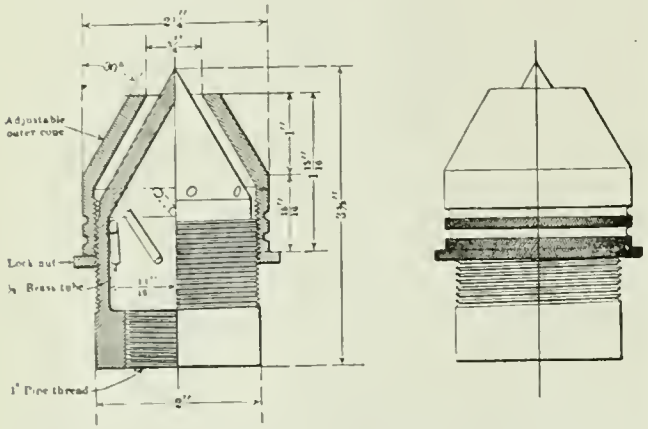
Prepared for this review by T. Aird Murray, Consulting Engineer, Toronto.

emphatic an opinion as Scott-Moncrieff has chosen to give. At the same time it would be most objectionable apart from chance of epidemic to locate sewage sprays in thickly populated districts, especially when the liquor sprayed is from septic tanks, the nuisance from smell is very bad indeed. The Royal Commission on Sewage Disposal, par. 158, state; "All forms of distribution in percolating filters are liable to give rise to nuisance from smell, if a strongly smelling liquor is to be dealt with. The nozzle form of distribution is naturally the most liable to give rise to smell."

In spacing out nozzles on a filter bed much depends upon the form of nozzle proposed to be used and the available head pressure. The head should never be less than 3 feet, and the most effective head is found between 6 and 7 feet. There is such a wide difference, however, in the various forms of nozzles now in use that in adopting any particular type, the correct spacing can only be determined by experiment with various heads. It has already been noted that owing to a spray forming a circle, there must be always four corners of the bed between each spray unwetted. As a circle is .7854 of the area of a square, about 78 per cent. of the total area of a filter only receives sewage. This area can, however, be increased to about 90 per cent. by allowing the circumference of each wetted area to overlap, this method is adopted in practice.




**Sprinkling Nozzle, First Used at Columbus Ohio.**

The difficulty of evenly wetting the whole area enclosed by the circumference of the spray, has been met to some extent by using a varying head. It is obvious that with a high head the portion of the filter bed immediately around the nozzle is overthrown. The action of a variable head, which means a gradual reduction of pressure draws in the circumference until the last of the dose simply wets the area around the nozzle. The objection, however, to a variable head is, the lack of uniformity in quantity distribution.

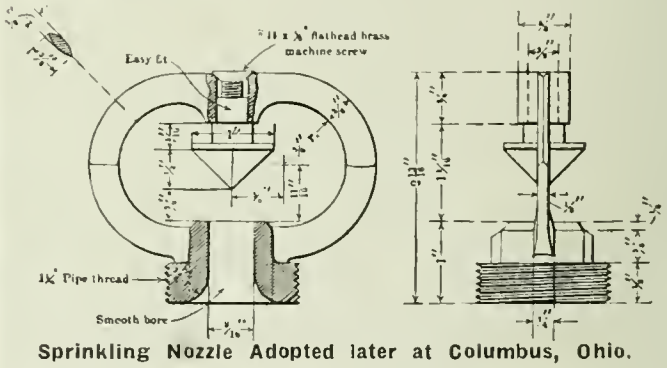
Uniform distribution by means of fixed sprays is greatly affected by winds. It is no uncommon occurrence to find the sprayed sewage at the edge of beds blown clear away from the filters in exposed positions.

Approximately the diameter of circle wetted by a nozzle may be taken at 2'-0" for every 1 foot head. With the Columbus sprinkler, 131 nozzles per acre of filter, at a 4.3 foot head, would provide a rate of filtration of 2,000,000 gallons per 24 hours; being equal to a rate of 10.9 gallons per minute, but only about one-third of the area would be dosed, which would really give a rate of 6,000,000 gallons per acre, the nozzles being spaced 19 feet apart. In order to increase the wetted area and obtain more uniform distribution, the head is varied from 7½ feet to 4.3 feet, providing respectively 13.5 gallons and 10.9 gallons per minute discharges.

At 13.5 gallons per minute discharge the nozzles are spaced about 16 feet apart; requiring 180 nozzles per acre, equal to a filtration capacity of 3,500,000 gallons per acre per day. As the quantity, however, wets about 92 per cent. of the total filter area, the rate is really 4,000,000 gallons per acre per day. Such a filter is only operated half the time so as to reduce the rate to 2,000,000 gallons per acre per day.

The above rate of 2,000,000 gallons per acre per day works out at about 225 gallons per cubic yard of filtering material, allowing a filter bed 6 feet deep. This may appear a high rate as compared with the rates of filtration as recommended in the British Royal Commission report for percolating filters, but it must be understood that the figures apply to American practice which deals with a much weaker form of sewage. Indeed, generally speaking, the rates as given by the Royal Commission can be doubled for treating American sewage. Rates of sewage treatment in proportion to filter area depend principally upon the organic strength of the sewage, and this again depends upon the amount of dilution figured upon the water supply per head per day. American rates of water supply are about double British rates.

In order to obtain an actual rate of continuous spray at 2,000,000 gallons per acre per day, providing about 225 gallons per cubic yard to a filter 6 ft. deep, the nozzles will




**Sprinkling Nozzle Adopted later at Columbus, Ohio.**

number about 390 per acre, spaced 11 feet apart. Each nozzle will wet a diameter of about 10½ feet at a variable head of from 4 feet to 2 feet, and provide a 4 gallons per minute discharge.

The pipes used for distributing the sewage to fixed sprays should be, generally speaking, of larger diameters than are necessary for the actual quantities of sewage. This must be obvious when the questions of friction and sedimentation are taken into consideration. The distributing pipes should be laid straight with screw cleansing caps at terminals so as to allow of cleaning. The upright branches to the nozzles are generally 3-inch diameter, providing for discharges of from 10 to 14 gallons per minute. In climates where frost is encountered it is necessary to lay the distributing mains on the base of the filter so as to maintain the temperature of the sewage. The method adopted at Birmingham of laying the mains on the surface of the filter would result in failure in North American climates.

The fixed spray has been received with greater favor in America than in Great Britain. In Great Britain travelling distributors and revolving sprinklers have come into general use. The advantages and disadvantages of the fixed spray may be summed up as follows:—

**Advantages.**

(a) No moving parts, therefore, not liable to freeze in cold climates.

(b) Comparatively a small first cost, the apparatus being simple and easily obtained.

(c) If properly installed easily kept open and clean.

(d) The main part of the distributing system protected from frost by the filtering material.

**Disadvantages.**

(a) Uniform distribution practically, up to the present, impossible.

(b) A maximum of 92 per cent. of the filter bed only in operation, usually 75 per cent. in operation.

(c) Constant attention required to keep nozzles clear.

(d) Possible nuisance from smell in the neighborhood, or possible distribution of pathogenic bacteria from the spraying operation.

Revolving sprinklers and travelling distributors will be dealt with in the following chapter.

(To be Continued.)

## PROGRESS REPORTS ON ABERTHAW TESTS OF ACTION OF SEA WATER ON CONCRETE.

Late in 1908 it was generally reported that tests had been undertaken by the Aberthaw Construction Company, Boston, Mass., in co-operation with the Navy Department at the Navy Yard, Charlestown, Mass., to determine by exposure over a long period what effect sea water might have upon concrete. The specimens were made of various grades of cement in widely differing proportions, and were so placed that the lower portion of the surface of each would be continuously exposed to water, while the upper portion was always exposed to air, and the middle portion alternately exposed to each. At the end of six months of actual exposure, which was recently terminated, a very critical examination was made. Although the specimens had been exposed to freezing temperature during several months of the winter, and to the variable conditions of midsummer, this examination failed to disclose any visible change in the surface of any of the specimens. It is independently stated by the cement chemist, Mr. H. L. Sherman, of Boston, that all cements are behaving in a perfectly normal manner and the tests to date appear to be perfectly satisfactory. It is his opinion that a considerable time must elapse before any results will be obtained which will tend to throw any additional light on the effect of the water on concrete, or on the effect of various compositions of cement.

## BOND OF CLAY AND CEMENT BRICK.

In connection with the use of cement for clay brick in the construction of their new mill, the Plymouth Cordage Company, of North Plymouth, Mass., made many interesting comparisons between brick made of the two materials. Bond was recognized as an essential feature in any method of construction, and in this respect cement bricks appear to great advantage. Clay bricks with one pallet side show a better bond than clay brick with both sides perfectly plain. It might be argued that cement brick with plain bed and build would furnish an inferior bond with the mortar. The fact is, however, that the cement brick is perfectly in bond with the mortar, to such a degree that the resulting wall is practically monolithic. Owing to the bond, attempts by the Plymouth Cordage Company to make cleanly cut openings in old work were a failure, unless great care was taken to first cut out the joints. If this was not done, the wall was defaced. Holes drilled through the wall would split out on the other side a space oftentimes over a foot square, especially when drilled from the inside. If mortar was left on the brick in laying, it was impossible to clean it off with any reasonable amount of water and acid and it could not be scraped off without defacing the wall.

The cutting of the cement bricks was found to be one of the most valuable features. It is possible to do almost anything with them. Cuts have been made half an inch thick, for the full length and width of the brick; ¼-inch cut from the full bed of a brick (except ½-inch from the face) to lay over and hide the edge of a casting. These are things which it is impossible to do with the ordinary clay brick

## NEW YORK NOVEMBER MEETING A. S. M. E.

At the New York November meeting of The American Society of Mechanical Engineers, to be held on the 9th, in the Engineering Societies Building, 29 West 39th St., at 8.15 o'clock, there will be two papers presented. One by Professor Gaetano Lanza and Lawrence S. Smith of The Massachusetts Institute of Technology, on "Reinforced Concrete Beams," and the other by Professor Walter Rautenstrauch of Columbia University, on "Stresses in Curved Machine Members."

The paper on "Reinforced Concrete Beams" is the same as that given at the Boston meeting of the Society on October 20th. It compares the results of tests upon full-sized beams made at the Massachusetts Institute of Technology, and the University of Illinois with three different theories of beams of this type.

The paper on "Stresses in Curved Machine Members," outlines the method of procedure for the design of principal sections of hooks, punch and shear frames and other curved machine parts. Experimental results are submitted in support of the theory presented.

The papers of the evening are of a character to draw out discussion upon the stresses in the elements entering into structures and machines and should result in the presentation of data on the general subject of stresses which will be of great importance to the designing engineer.

## UNION OF ALBERTA MUNICIPALITIES.

At the annual convention of the Union of Alberta Municipalities, held in Lethbridge, Alta, last week, a good deal of discussion was provoked by a paper on "Municipal Ownership of Public Utilities," by Mayor Jamieson, of Calgary, who advocated that the municipalities should own such utilties as waterworks, sewer and electric light systems, and street railways. The three former should be operated as absolute necessities and given to the people without regard to cost or profit. No municipality should give up the use of its streets. If a corporation can install and operate a street railway at a big profit, the municipalities, with good managership, could do the some thing, and, in addition, keep full control of their streets. He cited the experience of Calgary, which, in the few weeks since the system was put in, had made profits of over three thousand dollars above all possible charges.

The following new officers were elected: Hon president, W. O. Griesbach, Edmonton; president, H. H. Gaetz, Red Deer; first vice-president, R. R. Jamieson, Calgary; second vice-president, W. Gariepy, Edmonton; secretary-treasurer, John T. Hall, Medicine Hat; executive committee, T. Dickson, Macleod; H. L. Higgins, Wetaskiwin; W. Lawrie, Cardston; G. Hatch, Lethbridge; Mayor Lee, Edmonton; and Mayor Young, High River. The convention will be held next year in Calgary.

## THE TRACTION OF FREIGHT TRAINS AT DIFFERENT SPEEDS.*

By Clinton S. Bissell, M. Am. Soc. C.E.

The problem of railroad traction is to determine what a given tractive power can accomplish in overcoming a number of resistances, the principal of which is grade. The "ruling grade" is usually the maximum grade on a tangent, and the increase in resistance which would be introduced by curves on the ruling grade is, in the present day, done away with by equating or "slackening grade" throughout the length of the curve, with the purpose of producing a perfectly uniform resistance over tangents and curves alike. In the case of curves not thus equated, the additional resistance due to the curves must be applied as an increase to the ruling gradient throughout the length of each curve, and, if the proportion of curved line be considerable, the judgment of the engineer must decide upon what the ultimate "resisting gradient" will be.

Curves are commonly equated at rates varying between 0.02 per cent. and 0.10 per cent. of gradient per degree of curve, and 0.05 per cent. is a rate largely used for freight tracks where the speed is slow. It is well-known, however, that curve resistance does not vary uniformly with the degree of curve. Among authorities on the subject, the writer finds a general consensus of opinion to the effect that 0.05 for light curves and 0.02 or 0.03 per cent. for very sharp curves is about right, with intermediate values, approximately proportional. Using this as a standard, it is apparent that the amount by which the rate of the ruling grade should be reduced on curves is given by the following equation, in which C is the percentage of reduction and D is the degree of curve:

$$C = \frac{D}{D + 18} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This reduction is for curves on ruling grades where the train is not required to stop. Using Equation 1, a 1 per cent. grade becomes 0.9 per cent. when equated for a 2° curve, and 0.47 per cent. when equated for a 20° curve. In what follows, the term, g, means either the "resisting gradient" or the "ruling grade compensated for curvature," at about this rate.

In a paper† recently presented to the Society, the writer developed the following equation, expressing the form of variation in the case of the weights of heavy freight trains moving at the slow speed of from 10 to 7 miles per hour:

$$\text{Tons of train weight behind tender} = \frac{P - 20\,g\,m}{\frac{a}{b + W} + 20\,g} \quad \ldots\ldots (2)$$

in which P = the drawbar pull, in pounds, m = the weight of the locomotive and tender, in tons, a and b are constants, W is the average weight per car of the train, in tons, and g is the rate of the ruling grade, in percentage, the ton being of 2,000 lbs. For a locomotive, weighing, with its tender, 168 tons, exerting a drawbar pull of 32,100 lbs., and hauling a train of modern high-efficiency cars, which is representative of ordinary conditions, this equation becomes:—

$$\text{Tons of train weight behind tender} = \frac{32\,100 - 3\,360\,g}{\frac{249.6}{11.2 + W} + 20\,g}.$$

In order to adapt Equation 2 to speeds greater than 10 miles per hour, two changes must be made. As the speed increases, the drawbar pull, P, decreases; and, to a much less extent, the car resistance, $\frac{a}{b + W}$, increases. The variation in the drawbar pull is unquestionably in the form of a curve, and elaborate modern tests** have shown that the rate of change is comparatively low at high speeds, becoming more and more rapid as the speed decreases, until near the limiting maximum value of the tractive power. At this point the curve usually exhibits a quick decline, producing contrary flexure; and, for modern heavy locomotives, this takes place at a speed of between 10 and 6 miles per hour. Such a variation cannot be expressed algebraically without great complication, but fortunately the major part of the curve, above 10 miles per hour, may be expressed very simply as an algebraic equation. From the records of the Pennsylvania Railroad Company the writer obtained the following data pertaining to a heavy freight locomotive of the type used in this study:

| Speed, S, in miles per hour. | Drawbar pull, P, in thousands of pounds. |
|---|---|
| 10 | 32.10 |
| 16 | 22.37 |
| 30 | 10.35 |

Observing that a suitable form of equation for a curve through these points is:

$$P = \frac{h - k\,S}{n + S},$$

in which h, k, and n are constants, and S is the speed; and deducing the constants, the expression for the drawbar pull becomes:

$$P = \frac{863.5 - 14.1\,S}{12.5 + S},$$

in which P is in thousands of pounds, and decreases as the speed increases, in proper proportion, as shown on Fig. 1.

The second step is to find an expression for the increase of train resistance, in pounds per ton, in proportion to the increase of speed. For this purpose the writer refers to the paper§ "Virtual Grades for Freight Trains," by A. C. Dennis, M. Am. Soc. C.E. Fig. 1 of that paper exhibits several curves of train resistance, and, commenting upon them, Mr. Dennis says:

"The train resistance, in pounds per ton, compensated for change in velocity head, grade and curvature, was plotted for very many points and speeds for each train, and the mean of these points taken, as nearly as possible, for each train. Fig. 1 shows what is believed to be the correct resistance under the conditions given, and differs radically from the results obtained by Wellington and other authorities experimenting with light trains, cars and rails."

For this investigation the writer selected the curve marked "52 Loaded Box Cars. Tare 37 per cent. of Gross Weight.

*American Society of Civil Engineers, Vol XXXV., No. 7, page 847.

†"The Maximum Weights of Slow Freight Trains," by C. S. Bissell, Transactions, Am. Soc. C.E., Vol. LXIV, p. 303.

**For example, "Locomotive Tests and Exhibits, Pennsylvania Railroad System, Louisiana Purchase Exposition," 1904.

§Transactions, Am. Soc. C.E., Vol. L, p. 1.

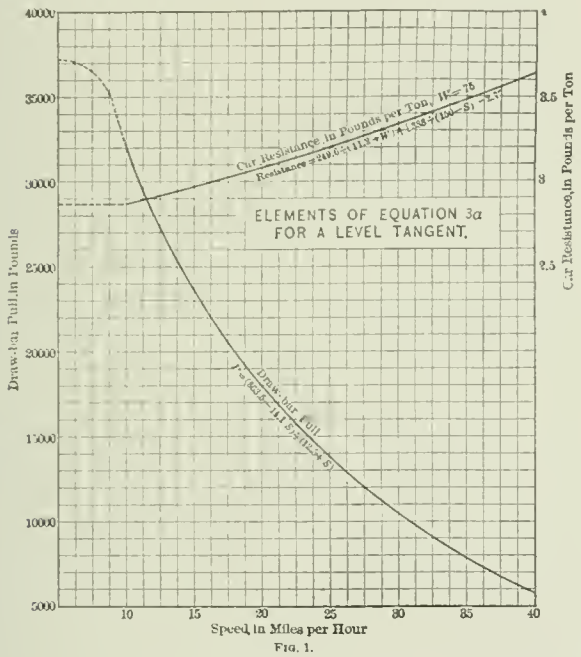
Track Soft," and used only that portion which is for a speed greater than 10 miles per hour. Taking the ordinates by scale, the following was obtained:

| Speed, S, in miles per hour. | Resistance, Y, in pounds per ton. |
|---|---|
| 15 | 4.50 |
| 25 | 4.73 |
| 35 | 5.00 |

in which the resistance, 4.73, is about 0.1 greater than as shown by the curve. In the light of Mr. Dennis' comments, this slight modification will not vitiate the accuracy of the following expression for resistance, which was deduced in the same manner as that for drawbar pull. The curve,

$$Y = \frac{388}{150 - S} + 1.625,$$

passes through the three points tabulated above. Had the modification not been made, the numerator of the fraction would have been smaller and the denominator, 150 — S, would have become about 47 — S. For speeds near 47 the variation would then have become much too great, since the curve has a rapid flexure on approaching its asymptote, S = 47. Under the circumstances, this slight change seems preferable to the complication necessary for a more exact treatment of the case.


ELEMENTS OF EQUATION 3a
FOR A LEVEL TANGENT.
Car Resistance in Pounds per Ton, W = 75
Drawbar Pull
Car Resistance, in Pounds per Ton
Speed, in Miles per Hour
FIG. 1.

The value of Y for a speed of 10 miles per hour, according to this equation, is 4.396 lbs., and the increase in resistance at this speed must be zero, hence the constant, + 1.625, becomes — 2.77, and the expression for increase in resistance due to speeds exceeding 10 miles per hour is:

$$\text{Increase in car resistance} = \frac{388}{150 - S} - 2.77.$$

Denoting the constants by the letters, r, t, and c, and substituting the two expressions in Equation 2, the general equation is formed:

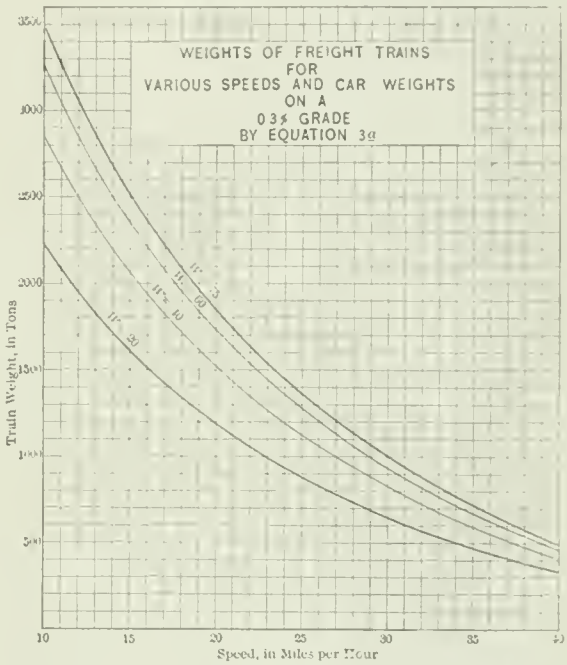
$$\text{Train weight, in tons, behind tender} = \frac{\dfrac{1\,000\,(h - k\,S)}{n + S} - 20\,g\,m}{\dfrac{a}{b + W} + \dfrac{r}{t - S} - c + 20\,g} \quad (3)$$

in which S is the speed, in miles per hour, W is the unit of train weight behind the tender, expressed as the average weight per car, in tons, and the remaining letters are constants, as heretofore designated. Substituting in Equation 3 the constants for the locomotive and cars used in the given example, there results the equation:

$$\text{Train weight, in tons, behind tender} = \frac{\dfrac{1{,}000\,(863.5 - 14.1\,S)}{12.5 + S} - 3\,360\,g}{\dfrac{249.6}{11.2 + W} + \left(\dfrac{388}{150 - S} - 2.77\right) + 20\,g} \quad (3a)$$

It will be noted here that the train weight varies with a multiple of the square of the speed, which is in accordance with past experience.

As a matter of suggestion, the writer wishes to call attention again to the expression for increase in train resistance due to speed. Regarding the curve passing through the points, S = 15, Y = 4.5, and S = 35, Y = 5.0, as a circle tangent to the direction of abscissas at S = 0, and applying the principle that "the square of any distance divided by twice the radius will equal the distance from tangent to curve very nearly"* the radius is found to be 1,000. This gives the




rate of increase in resistance as 0.0005 $S^2$, increasing from S = 0. For S = 10 the value is 0.05, and therefore the increase in resistance above 10 miles per hour will be (0.0005 $S^2$ — 0.05), which may be substituted in Equation 3a for the expression $\frac{388}{150 - S} - 2.77$, if desired. The results are practically identical, the difference at 50 miles per hour being only 0.09 lb. per ton. The writer prefers the expression containing only the first power of S, because of its greater simplicity, and its flexibility in adaptation to data obtained by experimental tests. The curve on Fig. 1 marked "Car Resistance" shows the form of variation for an average car weight of 75 tons.

The results of Equation 3a for car weights of 20, 40, 60, and 75 tons, on a 0.3 per cent. grade, are exhibited in Fig. 2; and for similar car weights on a 1 per cent. grade in Fig. 3.

*This statement is to be found appended to tables designed by George T. Keith, M. Am. Soc. C.E.

The great effect which the car weight has is apparent from these curves.

The writer had completed the form of Equation 3a before he realized that the expression for car resistance was a form over which there has been much discussion and disagreement in years past. Those interested will find in "Economics of Railroad Construction," by Walter Loring Webb, M. Am. Soc. C.E., a carefully drawn comparison of formulae for "train resistance" identified with the names of Baldwin's Locomotive Works, Wellington, Barnes, Aspinwall, and Searles. All these formulae are of the form:—

Resistance, in pounds per ton = constant + multiple of velocity.

Professor Webb calls attention to the fact that only Searles' formula and Wellington's (which was based on Searles') contain a factor varying with the train weight, and he emphasizes the necessity of this element in any expression which aims to comprehend the entire range of variation. It is noticeable that the constant in the above form was evidently chosen to represent an average value for the expression, $\frac{a}{b + W}$, in Equation 3, and that, in the two formulae just mentioned, a part of the resistance is made to vary with the total weight of the train, thus rendering them more accurate for extremes of velocity.

It will be observed here that the factor, W, the average weight per car, is representative and comprehensive of all such terms as "weight the train," multiples of "length of train," "number of cars," or similar factors.

The remarks* of the late A. M. Wellington, M. Am. Soc. C.E., whose formulae are mentioned above, indicate a doubt as to his own determination of the proper total value of the various resistances. As a heading for some tabulated values he writes:

"Table 166. Train Resistance on a Level as Affected by Velocity Giving what may be considered as the ordinary working maximum, as computed from the general formula of Wm. H. Searles, coinciding closely with the apparent indications of the most recent† tests, but possibly as much as one-third too high for the resistances at high speeds under favorable conditions * * *."

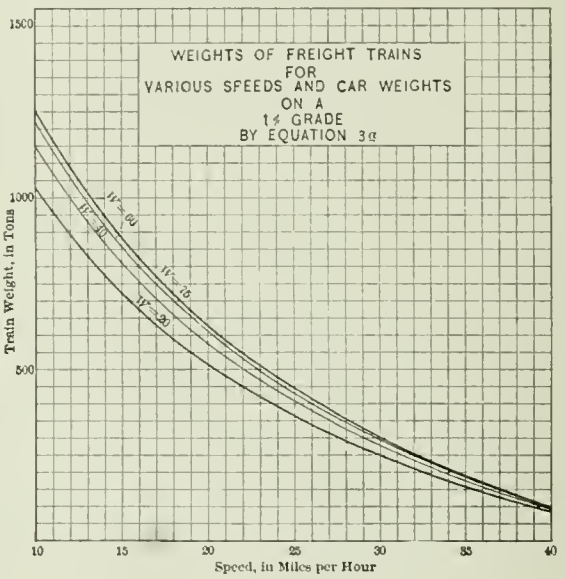
The principal resistances here referred to are evidently those of the atmosphere. To the writer's mind, the carefully executed tests made by Mr. Dennis have demonstrated that normal atmospheric resistances are not nearly as great as they were formerly believed to be; and, in using these tests for the developmnt of Equation 3a, the writer believes that the atmospheric resistances are represented by the slight upward trend of the curve used to show this variation.

Professor Searles says:** "A formula which shall express the resistance of a train to uniform motion must include at least the velocity and the weight of the train and engine."

In the development of Equation 3a, the writer has regarded the engine as merely the extraneous agent which supplies the drawbar pull. Since the drawbar pull contains no element of the internal or other resistances of the engine, the form of development has made it unnecessary that the engine weight should appear in the equation.

It has been difficult to obtain data with which to compare the results given by Equation 3a, but such comparisons as could be made have been satisfactory. In formulating the equation, the great object has been to deduce expressions which would represent the variation accurately to a point well beyond the extreme limit of speed. Recognizing that the problem is not one of absolute precision, the writer has in all cases used curves involving only the first power of the independent variable in preference to more complicated forms. The constants for each of the three curves, that is, the drawbar pull, the car resistance, and the increase in car resistance, must be determined by actual tests, and, therefore, upon the excellence of the tests depends the accuracy of the results. From good tests the constants can be easily deduced for each curve by a simple algebraic process. When this has been done, the car resistance constants may be retained, and only those in the expression for drawbar pull will need to be changed in order to suit the type of locomotive used.

The great disparity between the results of formulae which have heretofore been deduced to express the resistance




of a train at diffrent speeds seems to have arisen from either a failure to recognize the effect of the relation of the train weight to the number of cars, or else from an attempt to deduce an average value to represent it, which is obviously impossible. The absolutely correct formula would require an expression for the speed and also one for the weight and resistance of each particular car, which is impracticable. The nearest approach to this form would be an equation containing the speed factor, the number of cars, and the weight of the train, and this is the form of Equation 3, except that the two latter factors have been merged into one, "the average weight per car" of the train, which is a most convenient expression for the purpose to be served.

Equation 3 is adapted for use in all cases of hauls made by locomotives of either steam, electric, or other motive power; and also in cases of multiple-unit trains since each unit may be considered as a separate train. The general method of developing the three curves will be the same as exemplified above, except that the form of one or more of them might need to be changed to suit special forms of cars. It does not appear probable, however, that such a change will be necessary, for many years at least, except perhaps in the curve for the increase in car resistance due to increase in speed. It is with great interest that the writer presents this development, in the hope that the discussion may bring out whatever fallacies or errors exist, in order that they may be rectified, if possible.

*"The Economic Theory of Railway Location," by A. M. Wellington, M. Am. Soc. C.E.

†Later than 1887. (The writer.)

**"Field Engineering," by William H. Searles, M. Am. Soc. C.E.

## DUST PREVENTION BY CALCIUM CHLORIDE.

From W. A. Mackinnon, Canadian Trade Commissioner at Birmingham, Eng., we have received the report of the official test made by the Roads Improvement Association of Great Britain. The judges were A. Dryland, A.M. Inst. C.E.; H. P. Maybury, county surveyor, Kent; Geo. W. Manning and W. J. Atkinson Butterfield, M.A. Assoc. Inst. C.E.

Introduction.—This official test of calcium chloride was carried out by the Roads Improvement Association (Incorporated) at the request of the manufacturers, Messrs. Brunner, Mond & Co., Limited, of Northwich, in pursuance of the association's policy of ascertaining and publishing trustworthy data as to the cost and effect of various materials for fixing the surface dust.

Nature and Properties of Calcium Chloride. Calcium chloride is produced in large quantities as a bye-product in the ammonia-soda process of manufacturing common washing soda and in certain other chemical processes. It may be obtained in a number of forms, varying in composition only according to the amount of water contained therein. For instance, the common crystals of calcium chloride contain about 50 per cent. of water and 50 per cent. of true calcium chloride. Another fairly defined modification contains about 76 per cent. of calcium chloride and 24 per cent of water. By strong heating it may be obtained free from water. In all these, and in intermediate states, it has the property in a marked degree of absorbing moisture from the surrounding atmosphere, and if left exposed to damp air it eventually becomes a thick, syrupy liquid through the absorption of moisture. If it is then exposed to a dry atmosphere it will gradually part with some of this moisture and re-absorb moisture when again exposed to a moist atmosphere. It is on this property of absorbing large quantities of moisture that the utility of calcium chloride for laying dust on roads depends. The salt as supplied by the entrants for the "dry" method of treatment was in a granulated form, and contained about 70 per cent. of true calcium chloride and 30 per cent. of water. The effect of spreading this salt on the road is that it rapidly absorbs moisture from the atmosphere; the granules soon become soft, moist globules, which ultimately liquify by further absorption of moisture, and are then absorbed in the pores or interstices of the road-surfacing material. The syrupy nature of the liquid which results from calcium chloride by the absorption of water hinders its removal from the road material by washing due to rainfall, though ultimately prolonged wet weather must result in the extraction of nearly the whole of the salt from the material. The trials demonstrated, however, that even in very favorable conditions for the removal of the salt from the road material by rain an appreciable amount was retained for several weeks. When absorbed in the pores and interstices of the road the calcium chloride takes up or gives off moisture according to the degree of humidity of the atmosphere at the time. Thus, on a dry, hot day it will tend to become dryer, but will never in the conditions in this country pass beyond a certain stage, in which it is still a syrupy substance, having more or less binding action, due to its viscosity on the road material in which it has been absorbed. On the other hand, when the humidity of the atmosphere is increased, as is commonly the case at nightfall in this country even on dry days, the calcium chloride absorbed in the road will take up moistture from the atmosphere, and thereby render the road material moister than before. Thus in summer weather the effect of the treatment of a road surface with calcium chloride is to provide the material of the road with an ingredient which keeps it in a slightly damp condition by absorption of moisture from the atmosphere. Even in the dryest and hottest weather the road cannot become absolutely dry, and any dust or small particles which are picked up from it must, owing to the heavy, syrupy solution of calcium chloride incorporated with them, be disinclined to break up into small, fine particles, which would be carried or held in suspension for any appreciable time in the atmosphere. Consequently, any dust which may be raised from a road treated with calcium chloride is of a denser and less finely divided description, and so falls to the ground more rapidly. Calcium chloride is a body without any pronounced toxic or corrosive properties. By its solution in water the temperature of the water is considerably reduced for the time being, and a solution of calcium chloride in water freezes at a considerably lower temperature, depending on the amount of salt in the solution, than pure water.

Place of Test.—The test was conducted upon a stretch of road, constructed of granite macadam with water binding, one mile in length, from Ashford Station towards Stanwell village, in Middlesex, known as the Stanwell Road, Ashford.

Material Used.—The material used was calcium chloride in granular form. The entrants supply this material in barrels, holding approximately 9 cwts., at 50s. per ton, free on rails at their works, Northwich. They also quote the following prices:—

62s. 6d. net, per ton, delivered North London Station.

59s. 2d. net, per ton, delivered F.O.Q., Glasgow.

54s. 2d. net, per ton, delivered Manchester Station.

Methods of Treatment.—The entrants proposed that two methods of application of the material to the road should be tested:

(1) By dissolving the granular calcium chloride in water and spraying it in solution upon the road from an ordinary watering cart (referred to in the report as the "wet" method; and

(2) By distributing the granular calcium chloride dry over the surface of the road (referred to in the report as the "dry" method).

The mile stretch of road allotted for the test is divided by the main London-Staines Road running across it. The section between Ashford Station and the crossing of the London-Staines Road, an area of 7,160 super yards, was treated by the "wet" method, and the other section, with an area of 4,400 super yards, from the juncture with the London and Staines Road towards Stanwell Village by the "dry" method.

Dates of Treatments.—The entrants' process is to give the road two initial treatments, twenty-four hours between each. Monday and Wednesday, May 24th and 26th, were originally arranged for the treatments to be applied. The treatments were duly applied on Monday, May 24th, in fine weather. Details of the material laid on, amount of labor employed, etc., will be found in Schedule No. 1 appended. On the night of Monday, May 24th, approximately an inch of rain fell, and, as rain continued on the Tuesday and Wednesday (the rainfall for the three days amounting to 1.36 inches), the judges acquiesced in the request of the entrants that the test should be postponed, owing to the inclement weather. June 12th and 14th were thereupon fixed for the treatments to be applied. As the section that had been treated by the "dry" method still showed some effect of the treatment on June 12th, the date fixed for the first of the re-treatments, it was decided not to treat further that section of the road, but to keep it under observation. The effect

of the "wet" treatment having disappeared, being practically washed out on May 25th, it was decided to re-treat that section (London Road to Ashford Station) by the "dry" method, and that no further trial should be made of the "wet" method. Schedule No. 2 appended gives particulars of the material laid down, labor, etc., in connection with the treatments on June 12th. This section was further treated on June 14th.

Analysis.—In order to obtain information as to the amount of calcium chloride retained by the road material after the lapse of a definite period, samples of the road material were taken from three different portions of each of the treated roads to a depth of 1½ to 2 inches from the surface, and the chlorine present therein was estimated. In order to exclude the small quantities of chlorine that might have been present in the road material before application of the calcium chloride, similar samples were taken from portions of untreated road of similar construction in the immediate neighborhood, and the chlorine present in this untreated road material was determined. The amount found in the untreated material was deducted from that found in the material from the treated portions of the road, and the difference consequently represented the amount of chlorine added to the road material through the application of calcium chloride. The amount of chlorine thus found in the material from the treated portions of the road in excess of that in the untreated portions is stated below in terms of the equivalent amount of 70 per cent. calcium chloride as used for the treatment of the road. The samples of road material were all taken on 13th July; i.e., approximately seven weeks and four weeks after the two portions of the road had been treated. It was thus found that the calcium chloride remaining in the road material at the end of seven weeks after the treatment on 24th May amounted to 0.21 pound per square yard of road surface, and that remaining in the road material one month after the treatments on 12th and 14th June amounted to 0.4 pound per square yard of road surface. A portion of the latter amount may be ascribed to the previous wet treatment. These figures must be taken as only approximately exact, owing to the difficulty of obtaining a small sample of the road material representing an accurately measured area of its surface, and to the fact that the calcium chloride probably penetrates to a greater depth than two inches below the surface. It may, however, be accepted that the amount of calcium chloride retained by the road material is not less than the amount stated, and is probably more. It is likely, however, that calcium chloride, which may have penetrated to a greater depth than two inches, would be practically useless so far as the suppression of dust is concerned. The amounts stated represent at the end of seven weeks about 40 per cent., and at the end of one month 57 per cent. of the amount of calcium chloride applied to the road, assuming the original dressing by the wet method had by that time become exhausted.

Judges' Comments.—We are of opinion that the results of the tests of calcium chloride applied in granular form by the "dry" method have shown that it is a very effective dust layer, and, provided no ill effects are experienced in winter as a consequence of the treatment, we are of opinion it is a cheaper and preferable process to that of street watering, which, as now carried out, is undoubtedly very injurious to macadamized roads.

SCHEDULE No. 1.

Official record of time occupied, material used, labor employed, etc., in connection with the treatment of granular calcium chloride applied to the road on May 24th by the "dry" method:—

Date of Treatment—Monday, May 24th, 1909.
State of Weather—Very hot, sunny and dry. Temp. about 110° Fahr. in sun.
Name, Length, and Area of Road—Town Lane, Stanwell—from London and Staines Road towards Stanwell.

| | |
|---|---|
| Length of Road | 880 yards |
| Average width of road | 5 yards |
| Area treated | 4,400 yards |

Nature of Treatment—Material applied by "dry" method.

| | Rate. | Amount. |
|---|---|---|
| Preparation of Road and Labor— | | |
| Only manure, paper, etc., removed, one man, ¾-day | ¾-day | $0 60 |
| Net amount of granulated calcium chloride used: 20 cwt., 0 qr., 16 lbs. = 2,256 lbs. | 66/3 per ton (50/- material and 16/3 carriage) | 16 20 |
| Labor—Loading material into barrows and spreading: 5 men, 2 hours each | 6d. per hour | 1 22 |
| Carting: 1 horse, 1 cart and 1 man, 3 hours each | 1/- per hour | 73 |
| Entrant's foreman instructing and assisting in all above work: 3 hours | 7½d. per hour. | 45 |
| Total cost | | $19 20 |
| = 42c. per sq. yard. | | |

General—The material was distributed on the surface of the road partly by shovels from a cart and partly by hand from pails.

2,256 pounds of material was spread over 4,400 square yards, or .51 of a pound of material to one square yard of road surface.

SCHEDULE No. 2.

Official record of time occupied, material used, labor employed, etc., in connection with the treatment of granular calcium chloride applied to the road on Saturday, June 12th, 1909, by the "dry" method:—

Date of Treatment—Saturday, June 12th, 1909.
State of Weather—Cold, showery. Temp. 58° fahr.
Name, Length, and Area of Road—Stanwell Road, Ashford—Ashford Station to London and Staines Road.

| | |
|---|---|
| Length of Road | 1,000 yards |
| Average width of road | 7⅛ yards |
| Area of road | 7,166 yards |

Nature of Treatment—Material applied by "dry" method.

| | Rate. | Amount. |
|---|---|---|
| Preparation of Road and Labor— | | |
| Only manure, paper, etc., removed, 1 man, ¾-day | ¾-day | $0 61 |
| Amount of Material Used—Net amount of granulated calcium chloride used: 22 cwt., 1 qr., 9 lbs. = 2,501 lbs. | 66/3 ton (50/- material and 16/3 carr.) | 18 08 |
| Labor—Loading material into barrows and spreading: 6 men, 2¼ hours each | 6d. per hour | 1 83 |
| Entrant's foreman instructing and assisting in all above work: 2¼ hours | 7½d. per hour | 38 |
| Total cost | | $21 10 |
| = 29c. per sq. yard. | | |

General.—The material was unloaded into hand barrows and spread by hand from pails.

2,501 pounds of material was spread over 7,166 super yards of road surface, or .35 of a pound of material per square yard of road surface.

## RECENT DEVELOPMENTS IN RAILWAY MOTOR CONTROL.*

By Clarence Renshaw, Westinghouse Electric & Manufacturing Company.

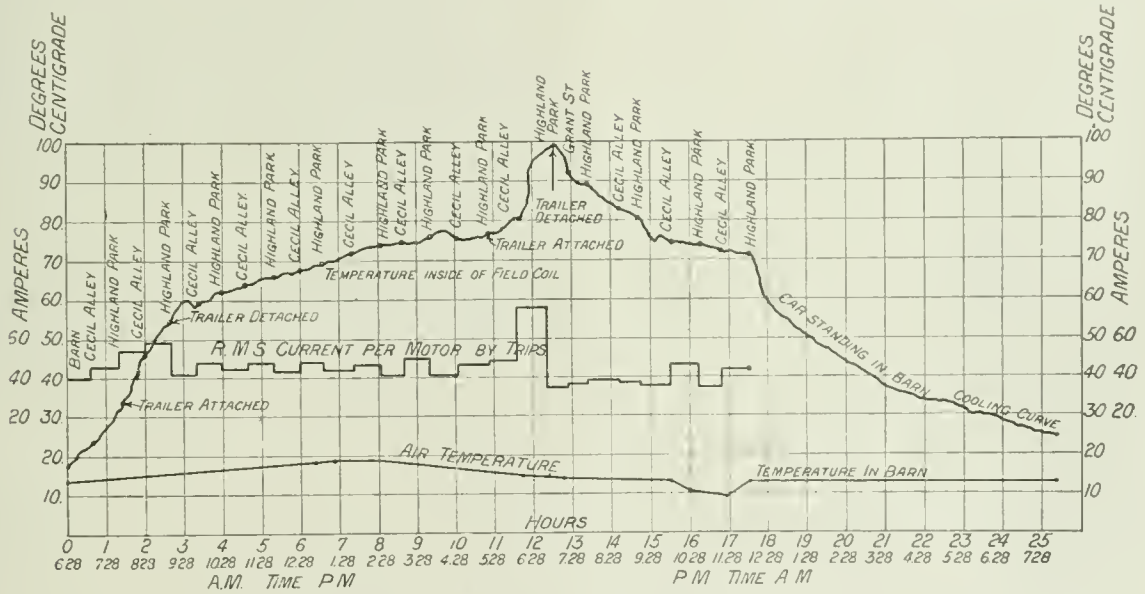
The control of railway motors, as practised to-day, depends upon some half a dozen or more fundamental principles, such as the magnetic blow-out, the series-parallel connection, the power-operated switch with indirect control, and so on, and during the period which may reasonably be included in the scope of this paper, there have been no new developments of this sort for me to chronicle. In the perfecting of details and the production of new forms, sizes and modifications of apparatus, however, many things of interest and importance have been done.

### Unit Switch Control.

The most important developments of the latter sort have been in the unit switch system of train control. Designed originally for elevated and electrified steam railroad service, this control has heretofore been made for use with automatic acceleration only, and with the power for operating the control circuits derived from a small storage battery on the car. throughout the country, where they are giving excellent satisfaction. Many operators, however, have hesitated in adopting the system for use on single cars or two-car trains, with equipments of moderate size, because of the apparent complications due to the automatic features, and on this account a much simpler form of unit switch control has recently been developed for use in such cases.

In the simplified form of unit switch control, the various connections between the motors and the resistances are made by means of seven or more (according to the size and number of the motors) pneumatically operated switches assembled together in a "switch group," and one pneumatically operated "reverser." Each switch is connected to the piston of a pneumatic cylinder, and normally held open by means of a powerful spring. The opening or closing of the switch is regulated by means of a magnet valve, connected to the cylinder, which admits compressed air when the circuit of the magnet is closed, and releases it when the circuit is broken. The reverser is moved to one or the other of its two positions by admitting air to one or the other of two cylinders similar to those on the switch group.

The supply of air for closing the switches is obtained from the main reservoir of the brake system, which is piped to an air chamber in the switch group, through suitable cocks and valves, together with an emergency storage tank for operating the car in case of failure of the compressor. The small amount of power which is required for operating the magnet valves is obtained from the trolley through a




**Curves Showing the Effect of Trail Car on Motor Equipment.**

In this system of control it is only necessary for the motorman to place the handle of the master controller in the series or the parallel position and the switches will then close automatically, under the direction of a current-limit switch in the motor circuit, and cut out the resistance until the full series or full parallel position is reached. This effect is accomplished by making the master controller merely close the magnet valve circuit of the switches required for the first step, and arranging other circuits so that the closing of these switches establishes new circuits to the magnet valves of the switches for the second step, and so on, by means of auxiliary contacts or interlocks mounted on switches.

This system of control is remarkably simple, considering the results that it accomplishes. About 1,000 or more of these equipments are in use on a number of large roads "control resistance," and its application is governed by a master controller at each end of the car. A direct wire from the magnet valve of each switch, or combination of switches, is carried to the master controllers, and these are so arranged that when the handle is moved to any notch, the circuit of the magnet valves of the several switches corresponding to that notch is closed and the switches are thus operated. By moving the master controller from notch to notch, therefore, the motorman starts and controls the motors in exactly the same way as with the ordinary hand-operated controller, except that instead of being mechanically connected to a re-

*Abstract of paper presented as Section (L) of the report of the Committee on Equipment of the American Street & Interurban Railway Engineering Association.

volving drum, located on the car platform and carrying the various contacts, the handle which he turns is connected by means of the magnet valves and pneumatic cylinders to much more powerful contacts close to the motors and underneath the car. It will be readily appreciated that such an arrangement is much simpler to understand than the automatic form, and as a matter of fact, the various circuits with this form of control can be as easily traced out as those of the ordinary drum-type controller.

The various circuits are carried to a multi-point train line receptacle at each end of the car, so that the circuits on two or more cars can be connected together by inserting a suitable jumper between adjacent receptacles, and the corresponding switches on each car can then be operated simultaneously by moving a single master controller.

Instead of the usual circuit breaker above the motorman's head, a small plunger is so arranged on the side of the switch group that when the current exceeds the desired amount the plunger is drawn in by the magnetic action of the blow-out coil at the end of the group, and by its movement opens the circuit to the magnet valves of the various switches, thus opening the switches. After having been opened in this way, the switches cannot be closed again until the master controller has first been returned to the "off" position. All of the main circuit contacts, therefore, corresponding to both controller and circuit breaker, are removed from the platform and located beneath the car.

The return of prosperity to the country after the recent period of depression is bringing to both city and interurban railway companies serious traffic problems which can best be solved by operating trains at certain times, instead of single cars. This matter was treated from an operating standpoint in a paper presented before the Transportation & Traffic Association last year by D. F. Carver, in which the advantages of train operation are clearly brought out.

Such trains could, of course, be made up of a motor car and a trailer, but at what expense to the equipment is indicated in the accompanying curve. This embodies the results of tests made by the writer a few years ago, and shows that the addition of a trailer (with the same seating capacity as the motor car, but somewhat lighter body and truck) for only one round trip of approximately one and one-half hours raised the temperature of the motors from its ordinary value of 75 degrees C. to about 100 degrees C., and that over two and one-half hours were required, after the removal of the trailer, for the motors to cool down again to the 75 degree point. Had the trailer been kept in service for a longer period, it is probable that a temperature of at least 110 deg. C. would have been reached, in spite of the Cool October weather during which the test was made. With multiple unit trains, consisting of two or more motor cars, however, the load on the equipment is even less when the cars are coupled in trains than it is when they are run singly, and it was with the idea of providing suitable apparatus, of the simplest and most reliable character possible, to enable such trains to be operated that the simplified form of unit switch control has been laid out.

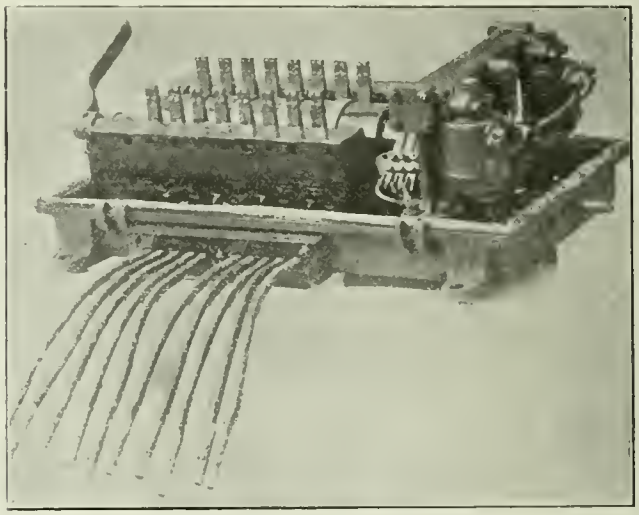
Nearly all of the essential features of the switches, magnet valves, etc., employed in this form of unit switch control, are not new, but have been in use for a number of years. We feel, however, that the simplification of the control circuits, and the general reduction in the number of parts required to make up a complete equipment, has now placed the apparatus on an entirely different basis, and opened up a new and wider field for its application than was ever before thought possible.

General experience shows that the introduction of a new method of accomplishing a given purpose always leads to improvements in the old method, rather than to its abandonment, as might be expected. As a result of this principle, the more common use of indirect control has led to various improvements and special features in the direct or hand-operated controllers.

One of these improvements is the use of an auxiliary unit switch contractor in connection with the controller, for reinforcing and protecting it. To accomplish this purpose a single pneumatically operated switch is mounted beneath the car, and the circuit to its magnet valve closed or opened by means of a pair of auxiliary contacts, operated by the main controller drum.

### Multiple Unit Operation with Hand-Operated Controllers.

In cases where double motor equipments are used instead of quadruple, and especially with single-end cars, two-car multiple unit train operation may readily be arranged for with ordinary hand-operated controllers. To secure this, it is merely necessary to use a four-motor controller and resistance on the cars instead of a two-motor one, together with suitable receptacles and jumpers for connecting the two motors on the rear car to the controller on the forward



**Pneumatically Operated Reverser.**

one. When this is done the two-car train then consists of a standard quadruple equipment with two of the motors on one car, and two on another, or, to use a term which is now becoming common in connection with electric locomotives, the two-car train really consists of an "articulated" car.

With double-end cars no simple arrangement can be made so that the cars will be interchangeable, but similar operation can be secured by providing a certain number of head-end cars and a similar number of rear-end cars, in which case only the former need have four-motor controllers. This latter arrangement, or one very similar to it, has been used in several places.

The use of a transformer on each car, from which any desired voltage, or number of voltages, for application to the motors can be easily obtained, makes the single-phase system as ideal from the control standpoint as it is from that of power supply. Variable connections from series to parallel are entirely unnecessary in this system, and the motors may be permanently connected in parallel, in series, or in series parallel, as desired, and simple and economical control se-

cured by merely connecting them to different voltage taps on the transformer. Owing to the self-induction of such motors, also, which tends to minimize the current fluctuations, smooth acceleration can be secured with comparatively few notches, a total of five being usually sufficient even with equipments aggregating 400 horse-power or more.

All of these various control schemes as applied to different sizes of motors have been used in service on various roads, and all have been remarkably successful and satisfactory. As an instance of this, the master mechanic of one of the large single-phase roads stated not long ago that he believed he was having less than one-half of the trouble with his control apparatus than he would have had with hand-operated, direct-current controllers.

## TAR AS APPLIED TO THE SURFACE TREATMENT OF ROADS.

By Hervey J. Skinner, Engineering Chemist.*

The problem of preserving the surface of roads and highways and the prevention of dust has been given attention by highway engineers for many years, but not until the year 1905 was the question seriously considered in the United States. The increasing use of automobiles and motor vehicles about this time introduced a new condition to be considered in the building and preservation of roads. Reports from various parts of the United States, England, France, and wherever the use of motor vehicles had become common showed that the automobile was exerting an extremely destructive effect upon road surfaces.

The macadam road has especially been subjected to this destructive action since it is the form of construction most commonly adopted for modern thoroughfares. The binder or fine material upon the surface of the road is removed by the constant passage of automobiles, thus exposing the larger stones, which become loose and which are either left on the surface or in windrows along the sides of the road. The roughened surface presents greater resistance to traction and allows water to percolate to the foundation of the road, thereby seriously injuring the whole structure.

Up to this time the macadam form of construction had been very satisfactory for the character of traffic for which it was designed, namely, that of iron-tired horse vehicles. In a perfectly constructed macadam road, the rock used is so adapted to the kind and amount of traffic that the fine material worn off from the rock replaces that which is removed by atmospheric agencies. Under ordinary conditions, it has been possible to maintain a hard and smooth surface at a moderate expense.

The advent of the automobile has changed very materially the character of the traffic. The action of the rubber tires is very different from that of iron tires and practically no dust is worn off to replace that removed by ordinary wear. The great tractive force or shear exerted by the driving wheels of motor vehicles is the main cause of this injurious effect. It has been demonstrated by a series of experiments in which separate speedometers were connected to the front and rear wheels of automobiles that there is a very appreciable amount of slipping of the driving wheels on the surface of the road. This slipping effect throws into the air large quantities of the fine surface material, which is caught by the air currents generated by the car body and subsequently removed from the road by the wind.

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Aside from the disintegrating action on the road, the dust raised by automobiles is a menace to health and a source of great discomfort to those living near much traveled highways, especially in residential sections. Another consideration of importance is the damage to property and in tances are reco ded where country estates have been disposed of far below their value and farms and orchards abandoned owing to the dust nuisance.

The increasing number of automobiles each year emphasizes their importance as a factor to be taken into consideration, and consequently highway engineers have given careful study to the necessity of making a change in the present practice of road construction, as well as evolving some method of preserving the surface of the enormous mileage of roads already built.

The increased cost of maintenance resulting from these changed conditions has resulted in a search for some method of surfacing other than that commonly used on macadam roads. Various materials have been proposed and used, some of which are temporary in their nature and are simply intended as dust preventives. Others are more permanent in character and are advantageous in actually binding the surface of the road together, thus becoming an integral part of the structure. Of this latter class, crude oil and tar are the most important and numerous preparations of these materials have been used with varying degrees of success.

Coal tar has been employed in road building for many years. Tar macadam roadways were constructed in Nottingham, England, as early as the year 1840, although under rather crude conditions. Coal tar pavements have been tried in various parts of the United States, but as a rule the results have not been satisfactory, asphalt being found superior as a paving material. In more recent years, tar macadam roads have been quite successful and this form of construction is now used to a considerable extent.

The application of tar to the surface of a completed macadam road, while comparatively new in this country, was tried in France about forty years ago. The results were rather unsatisfactory, but the practice has been carried on to some extent at intervals since that time, especially in Italy and France.

In the United States, the first experiment which attracted the attention of road engineers was in the summer of 1905, when a series of careful experiments were made at Jackson, Tennessee, by the United States Office of Public Roads in co-operation with the city engineer of Jackson, to determine the value of coal tar in the treatment of broken stone roads. The widespread interest created by these experiments led to similar ones in various parts of the country, particularly in Massachusetts, Rhode Island, New York, New Jersey and Pennsylvania.

The variation in the methods of application and the lack of attention to the quality of the tar and the condition of the road have led to a difference of opinion as to the real value of coal tar in surface treatment.

The methods of applying the tar have varied considerably, but perhaps the one more generally used, especially in the earlier experiments, is to remove the dust and all loose particles by thoroughly sweeping the surface of the road and then applying the tar from an open kettle mounted on wheels and fitted with a portable fire box. The tar is brushed over and into the surface with stiff brooms such as are ordinarily used for street work. The kettle is kept in advance of the workmen and by using two kettles and heating one while the other is in use, the process is made continuous. After allowing the tar to soak into the surface for at least ten

hours, it is covered with a layer of sand or fine stone screenings. When several hours have elapsed, the road is completed by rolling with an ordinary steam road-roller.

In some places, and particularly in Europe, mechanical means have been employed for applying tar. Some years ago, the Road Improvement Association held in England a competitive trial in which many of the machines were fitted with ingenious devices. Nearly all of them provided for heating the tar and applying it under pressure by means of compressed air. Some of them were designed for carrying on the whole operation with one passage of the vehicle. The dust and loose particles were first removed by suction and drawn up into a receiver. The tar was then applied by compressed air and spread over the surface of the road by means of automatic brushes. The fine material previously removed was again distributed over the surface and rolled by the steam-heated wheels of the machine. Some of these machines were drawn by horses, and others, the larger ones especially, were self-propelled.

The method most commonly used at the present time is a compromise between strictly surface application and tar macadam construction, and is known as the penetration method. In this method the surface of the road is broken up by means of a scarifier, new material added to fill ruts or other depressions, and the road re-shaped. After a slight rolling without the addition of water, the tar is applied and allowed to stand as in the previous method. A dressing of fine material is then spread over the surface and the road well rolled, with the result that a surface is formed in which all of the spaces between the hard stone are filled with a minimum amount of tar. A road treated in this manner is similar to one built by the tar macadam process, in which the stone and tar are mixed before being laid.

Many of the trials which have been made with tar as a surfacing material have failed because of a lack of appreciation of a number of important details. The structure of the road, its condition at the time of treatment, the traffic to which it is subjected, the character and amount of tar used, are all important factors which are necessary for successful results.

The structure of macadam roads varies according as each engineer has deviated from the original method of macadam construction to meet his own ideas. As a rule, however, the formation of the road is much the same and is of minor importance in comparison with the actual condition of the surface at the time the tar is applied. The road should be dry and as free from moisture as possible, since water and tar are not miscible in any sense, and if the tar is applied to a wet road, the latter is, so to speak, tar proof and proper penetration is impossible. In such a case, peeling of the surface is very liable to result, owing to the tendency of the tar to remain on the surface as a crust. It is equally important that the road surface should contain as little dust or loose material as possible, as the latter will absorb the tar instead of allowing the tar to be absorbed by the road. This again results in the formation of a crust, which under certain conditions will peel off, leaving the exposed surface of the road comparatively free from tar.

The kind and amount of traffic to which different roads are subjected is very variable and in cases where the traffic is particularly heavy or excessive, ruts and hollows are sure to exist. These irregularities in the surface make even rolling impossible and unless repaired previous to tarring water will collect in them and soon exert a detrimental effect upon the tarred surface. In many instances, traffic has been allowed on the road too soon after treatment, and this alone has been the cause of a number of failures.

The character of the tar is of almost equal importance as the condition of the road. Tars vary widely in composition even when produced by the same process. The character of the coal used, the method of carbonization and the temperature of distillation all have a decided influence on the composition of the tar. The value of coal tar in the surface treatment of roads depends almost entirely upon the binding power of its heavy bitumens. Besides these bitumens, there are present other substances such as water, ammoniacal liquor, oily constituents including the light oils and the creosote or "dead" oil, napthalene, anthracene and similar compounds, and free carbon, the proportion of which varies according to the manner in which the distillation process has been carried out.

The presence of water in coal tar has a similar effect as moisture in the road. If a tar containing water is applied to a dry road, the latter absorbs the water more readily than the tar, producing the tar-proof effect to which reference has already been made. Difficulty is also experienced in handling tar containing an appreciable amount of water since the water causes foaming, and if the vessel is heated by direct fire the danger of the tar going over the side of the vessel and taking fire is great.

Ammonia is another undesirable constituent, it being alkaline in nature and having a tendency to form with the oil constituents soluble compounds which are easily washed out by the action of the rain.

Napthalene and anthracene, while they exert no particularly harmful effect as in the cases of water and ammonia, have no binding power and their presence simply reduces the amount of bitumens which may be present.

Free carbon, like napthalene, has no detrimental effect, but, on the other hand, it is a useless constituent so far as road treatment is concerned and its presence reduces the binding power and waterproofing effect since it possesses none of these qualities itself.

The oily constituents of the tar are valuable to some extent since they act as diluents. The light oils are more or less volatile, and are probably evaporated soon after the tar is applied to the road, but their presence makes the tar thinner and consequently renders their application easier. The creosote oils are also of some advantage as it is claimed they add life to the tar and prevent its becoming too brittle.

The amount of tar is another important detail and if more is applied than the road can properly absorb, it will remain on the surface and be taken up by the top dressing with the resulting formation of a crust. Another objection to an excessive amount of tar is that it has a tendency to become sticky in warm weather and slimy in wet weather.

Sand or fine stone screenings have been used as a top dressing in the majority of the trials with coal tar, although occasionally the fine material removed from the road previous to tarring has been used. Stone screenings are probably the best material to use on a macadam road since they furnish a dressing of the same material as the road itself.

A comparison of coal tar with other road binders and dust preventives is somewhat difficult in the absence of really comparative experiments. Some few trials have been made in which different materials were used on the same stretch of road, but in most cases those experiments using such materials have been on different sections of roadways and consequently the results are not truly comparable.

Another cause for lack of comparative data lies in the great diversity of materials which have been used. As we have seen, the efficiency of a dust preventive is in proportion to its binding power and, therefore, a comparison of only those materials of approximately the same binding

power is justifiable. The various dust preventives really form a series from water, which has no binding power, up to coal tar and the heavy asphaltic oils, which have the maximum binding power of any of the materials yet proposed.

Water, salt solutions and light oil emulsions are of the nature of temporary binders, and are not to be compared with the more permanent ones such as coal tar and oils having an asphalt base.

The use of oil has been confined largely to the United States and by far the greater portion of the work has been done in the West, owing to the proximity of the oil fields which supply oils with an asphalt base. In the eastern portion of the United States the cost of transportation has been so great that comparatively little experimenting has been done with oil. Tar has been used quite extensively abroad, especially in England and France. In the United States, its use has been confined very largely to the eastern and northern states, although the park authorities of the larger cities have used tar to quite an extent.

Experiments have pretty clearly demonstrated that tar is not adapted for the treatment of gravel or soft earth roads owing to the fact that it does not amalgamate sufficiently well with these materials to bind them together. For roads of this class, therefore, oil has been more successful than tar. The use of tar has been and must be confined almost entirely to macadam or broken stone roads, and for roads of this nature it is probably more suitable than oil.

Oil, as a rule, has greater power of penetration than tar, but its value it dependent in a large measure to its asphalt base and before its maximum binding power is reached the more volatile constituents of the oil must be allowed to evaporate. This evaporation is a slow process and until it is complete the disagreeable odor of the crude oil will be apparent and more or less objectionable. The use of oil has also received considerable criticism owing to the damaging effect which it has upon clothes and the paint and varnish of vehicles, especially in damp weather, when a greasy, disagreeable mud is formed.

Tar, on the other hand, solidifies quite completely as soon as it is cold and does not depend except to a small degree on the gradual evaporation of its volatile constituents for its hardening. It is comparatively free from the objection of being picked up and thrown by the wheels of vehicles, and although it has a decided odor which lasts for a short time after application, this is not particularly objectionable and to most people is much less offensive than that of crude oil. An objection is sometimes raised to the use of tar on account of a fine black dust which wears off the tarred surface. It is true that such a dust is formed, but the amount is insignificant in comparison with the dust which would have formed if the road had been untreated.

It is claimed that coal tar has a decided antiseptic value, but how much importance can be attached to this feature is questionable. It is reported that an investigation was carried on in France to determine the number of germs present in the atmosphere over a tarred and an untarred road in the same neighborhood and the number over the latter was found to be considerably in excess of those over the tar treated section. Crude oil also possesses a similar antiseptic property, but to a very much less degree.

A properly tarred road is similar to an asphalt pavement although of a more resilient character. The stone is all bonded together by the tar into a smooth, firm surface which can be swept and washed in much the same manner as an asphalt pavement.

The principal agencies which cause deterioration of tarred or oiled surfaces are heavy rain, frost and the decaying organic matter which accumulates on the surface of the road. So far as can be determined one kind of road withstands the action of these agencies as well as the other.

Water gas tar is used in connection with coal tar, but not to any great extent by itself. It has a greater power of penetration and less of it is required, but it is not so lasting in character. It is really in a class by itself and occupies an intermediate position between the temporary and the permanent binders. In some cases where a limited amount of money is available or where for climatic reasons it is advisable to treat the road with the idea of its lasting only through one season, water gas tar should prove a valuable dust layer and any extension of its use will undoubtedly be in this direction.

The value of coal tar in the preservation of macadam roads and as a dust preventive is still unsettled. It is certain, however, that in the majority of cases the life of a treated road has been materially lengthened, and by applying tar the complete rebuilding of many roads at an enormous expense has been avoided.

One great drawback in the standardization of tar treatment is the impossibility of securing a uniform supply of coal tar. Coal tar is purely a by-product and the processes by which it is derived are never run with reference to the quality of tar produced, but solely to obtain maximum yields of gas or coke, as the case may be.

The impossibility, therefore, of manufacturing tar to meet definite requirements makes it necessary to utilize the supply available, but in so doing a certain amount of selection can be exercised and changes made whereby some degree of uniformity is obtained. Some attempts have been made to control the quality of the tar, but with rather unsatisfactory results. The manufacture of special coal tar preparations was intended to provide a greater uniformity, but many of these are, in the opinion of those who have used them, very variable and the success attending their use is not in proportion to the extra price paid for them.

Strictly surface treatment of an already existing road, even under the best conditions, can only be regarded as a temporary expedient and its use will probably extend only in cases where for financial or other reasons the rebuilding of the road is not justified.

Partial reconstruction of the road whereby the surface is loosened, reshaped and the tar applied before the rolling is done is undoubtedly a method of considerable value and one which will find more general application in the future. Many highway engineers have predicted an entire change in the methods of road construction, but it is difficult to believe that the macadam method, which has been so universally and so successfully used for a long time, can be eliminated. It is more probable that some modification of the macadam form of construction will be adopted in which event the tar macadam method is sure to be one of the first to receive serious consideration.

## COMING MEETINGS.

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

**National Association of Railway Commissioners.**—Nov. 16. Annual meeting at Washington, D.C. Secretary, Martin S. Decker, Albany, N.Y.

**America Railway Association.**—Nov. 17. Annual meeting at Chicago, Ill. Secy., W. F.Allen, 24 Park Place, N.Y.

# CORRESPONDENCE

**[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Ed.]**

## THE PRICE OF ENGINEERING.

Sir,—The editorial on "Must the Young Engineer Serve Under Articles?" which appeared in the October 15th issue of the Canadian Engineer, was written apparently expecting the answer "yes"; but the editor has left the matter open for consideration.

In view of this it might be well to notice that an affirmative answer to the question would mark a critical point in the development of engineering in Canada. Whether the result of the suggested change would be for better or for worse, at all events there are several large problems involved which, up to the present, have been allowed to remain as "sleeping dogs."

In the first place it would hardly seem right to apprentice young men to engineers who are themselves in no way legally licensed as yet.

Second, the unfortunate differences (often imaginary) which seem to exist between college and non-college engineers must still be completely cleared away before the question of "articles" would be of value.

Third, is it not yet unanimously decided whether engineering is to be regarded as a profession, as a fad or as a paying business? Some believe in the first named; and some, it would appear, in the second; while occasionally you find a man sufficiently practical to accept the third conception.

To say the least we are at sixes and sevens on these points which, together with some other problems must obviously be solved in conjunction with that of apprenticing.

If these combined results could be attained there would be little doubt as to the ultimate good effect upon the engineering of this country. However, it is doubtful what influence the suggested change might have upon the financial aspect of engineering which under existing conditions is not wholly satisfactory. It is with this state of affairs the present article is intended to deal.

We are told that in Canada there are ten or twelve colleges grinding out young engineers, presumably for employment in this country. In addition to this we have a number of young men entering the work without technical training; and also an influx of foreign engineers, draughtsmen, etc. Decidedly we are suffering from over-production.

Let us consider first the effect on the young engineers (say those with not more than ten years' experience). In them, according to the law of supply and demand it means lower salaries, the which has for some time been declining. As a consequence the more ambitious will naturally seek employment in the United States. Such men are usually well appreciated by the far-seeing American employer, and they are lost to their native land.

In spite of the low salaries we still find Canadian youth quite as anxious to take a chance on the "manly profession." But no wonder in view of the luring inducements of "working for experience" and "love of one's profession" handed out periodically by fatherly "disinterested parties."

At the present time consulting engineers, contractors and engineering manufacturers are reaping a harvest due to over-production of office and field assistants. Offices are flooded with applications from bright, intelligent young men whose experience is usually sufficient to handle a high percentage of the work.

So much is this the case that Canadian employers have naturally become independent as regards their engineering departments. They know that plenty of men are available; and with an eye for present dividends only, the one aim is to employ the office staff at the lowest possible price, regardless of the ultimate effect.

Canadian offices frequently have the reputation of not holding men very long. This is probably due to the above reason. Lack of interest, dissatisfaction and inferior work are the sure outcomes of underpaid labor.

Let us now consider the effect of the present condition upon the consulting engineers, the contractors, etc., or in other words upon the actual cost price of engineering.

At first sight it would appear that the cost was lowered. However, upon examining other lines of business, departmental stores, for example, we find that those concerns with the best organization, and paying the highest prices for their skilled labor are producing the cheapest goods. Now how many engineering businesses in Canada can state that their organization is so perfect that, for instance, the average young men can enter their offices and remain absolutely free from the effects of petty favoritism or jealousy? And, also, that a young graduate with a few months experience can actually earn $100 or $125 per month?

Such conditions exist in the office of a well-known successful New York contractor.

At best engineering is a poorly paid occupation, and the present financial outlook is decidedly unfavorable for young and old from a monetary standpoint. It certainly devolves upon all members who take a practical businesslike view of their work to "boost" the price from top to bottom.

Experience in engineering is certainly necessary, but the deafening howl of the experience faddist throughout the country is not only lowering the price, but also in like proportion the confidence and respect of the general public in our national engineering.

If we felt certain that apprenticing engineers would raise the price, undoubtedly, if for no other reason, the change would be a God-send. But results in Europe have not worked thus. We might also glance at the conditions in electrical engineering where apprentice courses are of frequent occurrence. Starvation wages and general cut-rate prices have resulted.

Better organization and less internal friction will undoubtedly produce a better quality of work from juniors and increase their earning capacity. The ultimate benefit to all classes is evident. Good engineering is a valuable asset to the whole community and fully warrants the highest remuneration for all persons concerned. Yours truly,

R. E. W. Hagarty.

Toronto, October 1909.

## PROBLEMS IN APPLIED STATICS.

T. R. London, B.A.Sc.

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It is the intention in the following series of problems to first take up examples of a most elementary nature and gradually work up to the more difficult problems of every-day practice. Of course, it is primarily assumed that the reader is either conversant with a few of the elements of statics, or is in a position to read some work on the subject. In order to assist the reader, the laws which are to be applied in each problem will be given in heavy type at the head of each question. It will also be the endeavor to set a problem each week that will in some manner bear on the example just solved, and in the following week the explanation will be given, thereby enabling the reader to exercise his ingenuity.

**If the Vector Polygon be drawn for a set of forces which are in equilibrium, the polygon must close.**

Let Fig. 58 represent a chain passed through a pulley to which is attached a hook, as shown. If the

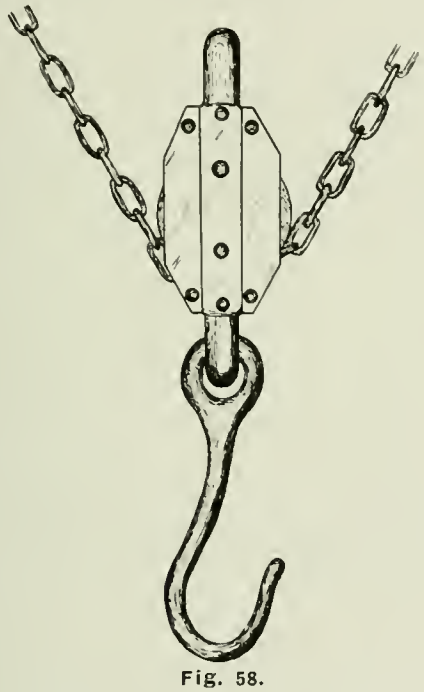

Fig. 58.

chain is inclined to the horizontal at 60° on each side of the block, what stress will be induced in the chain by hanging a weight of 3,464 pounds on the hook?

For all practical purposes the condition of affairs is such as indicated in the Statical Diagram (Fig. 59), a known force AB of 3,464 pounds acting vertically downward, and two unknown forces, BC and CA, acting in directions which are inclined at 60° to the horizontal.

It is required to find the magnitudes of the two forces, BC and CA.

The three forces AB, BC, and CA are in equilibrium; therefore, if their vector polygon be constructed, it must close.

To construct the Vector Polygon:—

From any initial point A (Fig. 60) draw a line AB to represent completely the vertical force of 3,464 pounds, which is known as the force AB, A and B being the letters on the areas to each side of the line representing the force in the Statical Diagram. (Such a system of lettering is known as Bow's Notation.) From B (Fig. 60) a line is drawn to represent the known direction of the so-called unknown force BC (Fig. 59).

Now, because the vector polygon must close, we know that the line representing the unknown force CA must pass through the initial point A (Fig. 60). Therefore, from A (Fig. 60) draw a line making 30° with AB; i.e., to represent the direction of the force CA. This line intersects the last line, drawn from B, at C.

BC and CA (Fig. 60) represent completely the hitherto unknown forces, and, since the sense marks in a vector polygon must point continuously from the initial to the final point (which in this case are coincident), the senses of BC and CA are as indicated by the arrowheads.

If now, the sense marks as found in Fig. 60 are placed on the representations of BC and CA in the Statical Diagram, it is seen that both BC and CA act away from the point; i.e., they are tensile forces. The chain is, therefore, in tension (tends to tear apart). This last fact might easily have been seen in the first place, for a chain could not transmit other than tensile forces; but it is dangerous practice to assume, without proof, conditions which seem to be self-evident.

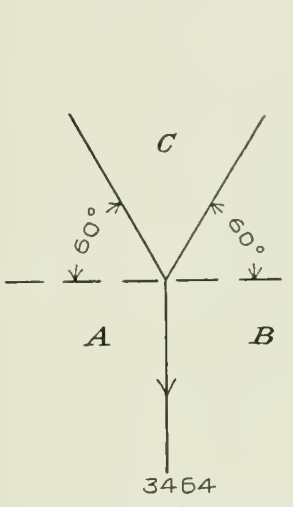


Fig. 59.

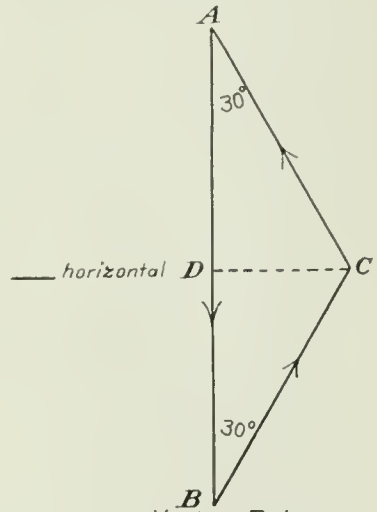


Fig. 60.

In order to find the magnitude of BC and CA, drop CD perpendicular on AB.

$$AD = DB.$$

Since AB represents 3,464 pounds,

$$AD = 1732 = DB.$$

$$BC = \frac{DB}{\cos 30^\circ} = \frac{1732}{1.732} \times 2 = 2000.$$

$$CA = \frac{AD}{\cos 30^\circ} = \frac{1732}{1.732} \times 2 = 2000.$$

If Fig. 60 has been constructed to scale, the lines BC and CA should each scale 2,000 pounds.

From the preceding it is seen, then, that the chain is **in tension** to the extent of 2,000 pounds.

The problem might have been stated in this manner: If the chain (Fig. 58) can safely stand tension to the extent of 1,500 pounds, what is the maximum weight that may be placed on the hook?

(This last problem will be solved next week.)

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ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrell.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB. — President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

## AMERICAN TECHNICAL SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS. — President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS. — President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

(Continued on page 50.)

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Oct. 14 1909 | EARNINGS Week of Oct. 14 1908 | STOCK QUOTATIONS TORONTO Price Oct. 14 '08 | Price Oct 7 '09 | Price Oct. 7 '09 | Sales Week End'd Oct. 14 | STOCK QUOTATIONS MONTREAL Price Oct. 15 08 | Price Oct. 7 09 | Price Oct. 14 '09 | Sales Week End'd Oct. 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,138 000 | 1,611.000 | 175 | 187½ | 186¼ | 185¾ 427 | 176½ | 176 | 186 | 186¼ 1549 |
| Canadian Northern Railway | 2,986.9 | | | 300.000 | 265,300 | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 914,860 | 840,583 | | | *1st. pref. 108½,3rd pref. 87½, ordinary 23¾ | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | 37,858 | 20,838 | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 77,673 | 70,483 | | | | | 188¾ | 188 | 214¾ | 214½ 212½ 210½ 637 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,280 | 68,560 | | 124¼ | 124 | 122 | 101¼ | 103¾ | 124¾ | 123¾ 125½ 124¼ 529 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 164 | 187½ | 187¼ | 60 | | 162¼ | 187¼ | 187¼ |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London Street Railway.

## THE INTERNATIONAL TRANSIT COMPANY, SAULT STE. MARIE, ONT.

President, Mr. C. D. Warren, Toronto.
General Manager, Mr W. C. Franz, Sault Ste. Marie, Ont.
Manager, Mr. T. J. Kennedy, Sault Ste. Marie, Ont.
Chief Engineer, H. Welburn.
Purchasing Agent, Mr. T. H. McGillivray, Sault Ste. Marie, Ont.

**Kind of Road:** Street Railway.

**Length of Road, in miles:**

Single track, 3.68.

**Character of Service:**

Car equipment, No., 8 motor cars; type, closed full vestibuled.
Number of motors, 6 cars, 4 motors each; 2 cars, 2 motors each; power of motors, 40 h.p.
Method of Controlling, unit control, G. E. Co.
Method of Braking, hand brakes, "Peacock."
Gauge of tracks, 4 ft. 8½ in.
Weight of rails, 80 lbs.

**Power:**

Direct current, D.C.
Voltage of transmission, 550 volts.
Trolley voltage, 500 volts.
Current collecting devices, overhead trolley, 6-in. wheel.

## KINGSTON, PORTSMOUTH & CATARAQUI ELECTRIC RAILWAY COMPANY, KINGSTON.

President, Mr. H. W. Richardson.
Superintendent and Purchasing Agent, Mr. Hugh Nickle.
Chief Engineer, John Evans.

**Kind of Road:** Street Railway.

**Length of Road, in miles:**

Single track, 8.
Total in single miles, 8.

**Character of Service:**

Number of motors, 46.
Type, G. E. 800-1.000-67
Power of motors, 35 and 40 h.p.
Method of braking, hand.
Gauge of tracks, 4 ft. 8½ in.
Weight of rails, 60 lbs.

**Power:**

Direct current, D.C.
Voltage of transmission, 500 volts.
Trolley voltage, 500 volts.

## RAILWAY ORDERS.

8265—October 5—Granting leave to the Norfolk Co. Tel. Co. to erect, place, and maintain its wires across the track of the G.T.R. at Lots 5 and 6, 14th Con., Tp of. Townsend, County Norfolk, Ont.

8266—October 5—Authorizing the Dominion Natural Gas Company, Ltd., to lay and thereafter maintain a gas main under the track of the G.T.R., where the same crosses Talbot Road, Tp. of Wyndham, County of Norfolk, Ont.

8267—October 4—Granting leave to the Kaministiquia Power Company to erect, place, and maintain its wires across the track of the C.N.R. at their intersection of Edward Street, West, Fort William, Ont.

8268—October 4—Authorizing the C.P.R. to construct, maintain, and operate branch line for the Kaufman Lumber Company at mileage 39.1, on the Sudbury-Kleinburgh Branch of its line.

8269—October 7—Granting leave to the C.N.Q.R. to place, and maintain its tracks and telegraph wires under the telegraph wires of the G.N.W. Telegraph Company and the C.P.R. Company at the crossing of the C.P.R. at Lachevrotiers, Parish of Deschambault, County of Portneuf, P.Q.

8270—October 7—Granting leave to the Manitoba Government Telephone system to erect, place, and maintain its wires across the track of the C.P.R. on Nairn Avenue, and Eaton Street, Elmwood, Winnipeg, Man.

8271—October 6—Authorizing the Saskatchewan Government Telephone system, to erect, place, and maintain its wires across the track of the C.N.R. near Craik, Sask.

8272—October 6—Authorizing the United Gas Companies, Ltd., to lay and thereafter maintain gas pipe under the track of the G.T.R. where the same crosses Forks Road, 1st Range from the river, Tp. Moulton, County Haldimand, Ont.

8225 to 8279—October 7—Granting leave to the Bell Telephone Company to erect place, and maintain its wires across the track of the P.M.R.R., M.C.R.R., C.P.R., and G.T.R. at various points in the Province of Ontario.

8280 to 8285—October 6—Granting leave to the Hydro-Electric Power Commission of Ontario, to erect, place, and maintain its wires across the track of the G.T.R. at six points in the Province of Ontario.

(Continued on Page 47.)

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received up to Wednesday, 27th October, for timber, and Portland cement. Specifications may be obtained upon application to Mr. F. W. Cowie, Chief Engineer, at this office. David Seath, secretary-treasurer, harbour commissioners, 57 Common Street, Montreal.

**Ontario.**

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

BERLIN.—Tenders will be received until Thursday, October 28th, for paving King Street. A. H. Millar, town clerk; Wm. Mahlon Davis, C. E., town engineer. (Advertised in the Canadian Engineer.)

BRANTFORD.—Tenders will be received until Wednesday, October 27th, for the construction of concrete and pile abutments for a bridge over Big Creek, near Kelvin Ont. W. H. Fairchild, C. E., 54 Market Sreeet, Brantford, Ont.

LATCHFORD.—Tenders will be received until Thursday, October 28, for the construction of a Dam and Sluiceways across the Montreal River at Latchford. Plans and specifications can be seen at the office of J. G. Sing, district engineer, Confederation Life Building, Toronto, and on application to the Postmaster at Latchford. Napoleon Tessier secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders are invited for a supply of pipe 42 inches in diameter, to cost about $64,000. Mr. N. J. Ker, City Engineer.

PORT COLBORNE.—Tenders are invited by this municipality for a pump with a capacity of 400 gals. per minute, in connection with waterworks extensions that are being made. Tenders for a 30 h. p. electric motor are also wanted.

TORONTO.—Tenders will be received until November 2nd for the construction of a gate house to be built over the South Tunnel Shaft at the Island. Joseph Oliver (Mayor) Chairman, Board of Control. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer).

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer).

TORONTO.—Tenders will be received until Wednesday 10th November, for all the cherry, birch, maple, spruce, hemlock and other classes of timber estimated to contain over fifty million feet of hardwood, and over fifty million feet of soft wood, on a tract situated on the Georgian Bay at Beaverstone River. McCarthy, Osler, Hoskins & Harcourt, Toronto Solicitors.

WESTON.—Tenders will be received until Monday, November 1st, for (a) laying 23,000 lineal feet of water mains, (b) steel water tower and foundation, (d) cast iron pipes and special castings, (e) fire hydrants, gate valves, valve boxes, etc., (f) sedimentation basin. R. J. Bull, Reeve; Willis Chipman, consulting engineer, 103 Bay Street, Toronto.

**Manitoba.**

WINNIPEG.—Tenders will be received up to Monday, November 1st, for supply of one motor hose wagon for the Fire Department, capable of carrying 2,000 feet of 2½ in. cotton, rubber-lined fire hose, approximate weight 2,200 lbs., and six men, approximate weight 1,020 lbs. M. Peterson, secretary, Board of Control.

**Saskatchewan.**

MOOSE JAW.—Tenders will be received for a supply of coal from the date of acceptance of the tender to the first of July, 1910, for the operation of the power plant of the city of Moose Jaw up to Monday, the 25th October. John D. Simpson, City Clerk.

MOOSE JAW.—Tenders for Laboratory Fittings will be received up to October 30th. J. W. Sifton, Secretary.

**Alberta**

TABER.—Tenders will be received up to 31st October, for the construction of a Waterworks System in the town of Taber. Geo. C. Millar, Secretary-treasurer.

**British Columbia.**

VANCOUVER.—Tenders will be received until November 9th, for building a large bridge over False Creek, this city. Messrs. Waddell & Harrington, consulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

## CONTRACTS AWARDED.

**Quebec.**

MONTREAL.—Tenders for the reconstruction of the bridge over the railway tracks on St. Catherine St., east, were:—Dominion Bridge Company, Montreal, $63,091; E. G. M. Cape, Montreal, $63,886. The contract was not awarded.

MONTREAL.—The new Royal Arthur School will be erected by Mr. C. E. Deakin, for $82,452.

QUEBEC.—Messrs. Simonean & Dion have been given the contract for building the Quebec Technical School, for $233,800.

**Ontario.**

TORONTO.—The Canada Foundry Company has secured a half-million-dollar contract from the Dominion Steel Company of Sydney, N. S. The work to be done is the extension of the Bessemer blast furnaces and plants, with two open hearth furnaces.

TORONTO.—The contract for one 650 kilowatt, 120 r.p.m. engine type alternator, together with switchboard, steam driven exciter and motor generator set, has been awarded to the General Electric Manufacturing Company of Sweden, through their representatives, Messrs. Kilmer, Pullen & Burnham, Toronto.

TORONTO.—The Dickson Bridge Company of Campbellford, Ontario, has been awarded a contract for the steel superstructure of the Wilton Avenue bridge. Their tender is for 875,644 pounds of material at $4.00 per cwt., $35,809. Sir William Arrol, of Glasgow, Scotland, whose tender was $45,645, estimated that the structure would require a million pounds of steel. His tender is at $4.41 a pound. F. H. McGuigan, of Toronto, bid $51,725, while the Motherwell Bridge Company of Motherwell, Scotland offered to do the work for $64,872. The Cleveland Bridge & Engineering Co., of Darlington, England, would do the work for $45,562.50. This tender was next to the lowest. In all, seven bids were received.

TORONTO.—On Wednesday, the controllers awarded the following asphalt pavement tenders: To Godson Contracting Co., Cecil St., Henry to Beverley, $1,620; Trinity Square, Yonge to 220 feet west, $970. To Barber Asphalt

Co., Lennox St., Bathurst to Manning, $4,055; Maple Grove, Brock to O'Hara, $1,053. To City Engineer, Glen road, bridge to Highlands, $1,830; Russell Hill Clarndon to St. Clair, $6,507; Heath St., Yonge to Avenue road, $11,077, Roxborough St., Edgar to Binscarth, $12,707.

TORONTO.—The following tenders were received by the city of Toronto for 1,080 lengths of 10-inch cast iron water pipe:—

| | Per length. |
|---|---|
| The National Iron Works | $27.45 |
| The Canada Foundry Company | 30.07 |

Other tenders, $31, $31.12, $32.30.

The National Iron orks, the company recently incorporated by Mr. Cawthra Mulock, will receive the contract. The material is to be delivered next spring.

**Manitoba.**

PORTAGE LA PRAIRIE.—The tender of L. B. Merriam of Merriam, Hyland & Plummer, Winnipeg, $10,530 for completing the needle dam here has been recommended by Mr. W. G. Chace, of Smith, Kerry & Chace, for acceptance.

WINNIPEG.—The Western Construction Co'y have the contract for the trench work in connection with a six-mile pipe line from the Red River at St. Boniface, to the N. T. Railway shops at Winnipeg. The 12" pipes with wooden bands will be supplied and installed by the Canadian Pipe Company of Vancouver, B. C.

**Saskatchewan.**

MAPLE CREEK.—A. P. Burns of Medicine Hat, Alta., has been awarded the contract for building about five miles of sewers here. Mr. C. M. Arnold, of Lethbridge, was the consulting engineer.

**Alberta**

CALGARY.—The order for four 750 k.v.a., water-cooled step-down transformers for the Calgary Power & Transmission Company has been awarded to the General Electric Manufacturing Company of Sweden, through their representatives in Canada, Messrs. Kilmer Pullen & Burnham, Toronto. Messrs. Smith, Kerry & Chace Toronto, consulting engineers.

CALGARY.—The contract for about 8,000 lbs., of wire for the balance of this year's electric light work was let to the Canadian General Electric Company, who have just opened a branch in Calgary, at $17.20 a hundred, with a discount allowance of the half of 1 per cent. for 30 days' cash. The tender of the Northwest Electric company was $17.70 with no discount, and that of the Enterprise Electric Company, $18.50. All these prices are f.o.b. Calgary.

**British Columbia.**

VICTORIA.—The Westminster Marine Railway Company's tender of $20,000 has been accepted by the Columbia Coast Mission for a boat with a 100 h. p. gasoline engine.

## SEWERAGE AND WATERWORKS.

**Ontario.**

OTTAWA.—Mr. N. J. Ker, city engineer, has been authorized to proceed with the construction of a pipe line from the end of the new aqueduct to the intake at Nepean Bay, a distance of one mile. The estimated cost of the pipe, whose inside diameter is to be 42 inches is $64,000.

WESTON.—Tenders are invited until Monday, November 1st, for the construction of waterworks. Mr. Willis Chipman, of Toronto, has charge of the work.

**British Columbia.**

VICTORIA.—The water pipes for the new distribution system in the municipality of Oak Bay have arrived, and the council have decided to lay them by day labor.

## RAILWAYS—STEAM AND ELECTRIC.

**New Brunswick**

ST. JOHN.—The Drummond Company, which is operating the iron mines in Gloucester County, N.B., have fifteen miles of the railway already graded, and the rails are now being laid. All the work will be finished by spring. At present 400 men are at work on the railway construction, and if it were possible to secure laborers the number might be doubled. About fifty men are at work at the mine putting in tracks and spurs and turning out the ore. The heavy mining machinery cannot be taken in until the railroad is completed.

**Quebec.**

MONTREAL.—Farnham car shops, in connection with the C.P.R. have been closed and the men and plant will be moved to Montreal to become part of the Angus shops. At the C.P.R. headquarters it was explained that the change was in the interest of economy and efficiency. Four hundred men are affected.

**Ontario.**

OTTAWA.—The Canada Gazette, this week, contains notice of a large number of applications to Parliament for new railway charters and for extensions of time for the construction of lines previously authorized. The Canadian Northern Railway asks for authority to construct eleven new branch lines and for an extension of time on fourteen lines in the west. The new lines proposed are from Dundee to the Winnipeg River; from Portage la Prairie southerly to township 2, range 7; from Hartney westerly to township 5, range 7, from Moose Jaw to Bienfait; from Davidson northwesterly to a point on the Saskatoon-Calgary line; from Lashburn, westerly to a point between Camrose and Edmonton; from a point on the Saskatoon-Calgary line to the Rocky Mountain House; from a point on the Saskatoon-Calgary line near the crossing of the Red Deer river north-westerly to Yellowhead Pass; from Winnipegosis southerly to the south end of Lake Manitoba; from a point on the authorized Prince Albert to Battleford line to the Great Slave Lake; from the east end of Lake Manitoba, via the Narrows, to the Grand View and Roblin branch.

OTTAWA.—The Dominion Government section of the Grand Trunk Pacific has cost to date $51,050,717, the National Transcontinental Railway Commission reports. During the twelve months ending March 31 last $24,892,772 was expended in construction between Moncton and Winnipeg. At the end of March there were 725 miles graded and 345 miles of track laid.

OTTAWA.—The toll of death in construction work on the National Transcontinental Railway during the last fiscal year was 68, while 22 men suffered serious injuries. The fatalities were, for the most part, caused by carelessness on the part of the men handling dynamite. Most of the killed were Italians or Swedes. There were over 12,000 men in the army of railroad builders during the past year.

TORONTO.—The Temiskaming & Northern Ontario Railway recently placed with the Canadian Locomotive Company, Ltd., of Kingston, Ont., orders for four freight, two passenger and two switching engines. The freight and passenger engines are 10-wheelers, 19 × 24-inch, weighing 146,000 lbs. in working order, of which 114,000 lbs. is on the drivers, and 32,000 lbs. on the trucks. The driving wheel base is 13 feet 6 inches; the total wheel base of engine 23 feet 8 inches. The passenger and freight engines are the same, with the exception of the driving wheels, which, for the passengers are 63-inch diameter, and for the freights 57-inch diameter. The switching engines are the usual 6-wheel type (0-6-0); weight in working order 128,000 lbs.; cylinders 19 × 26-inch; driving wheels 51-inch diameter, wheel base 11 feet 1 inch.

WINDSOR.—The removal of the bulkheads on Monday from the tubes at the Canadian end of the Michigan Central tunnel under the Detroit River, completely opened the subaqueous passage. Officers of the construction company made a trip of inspection under the river and found the passage practically free of water. The next work will be the electrical installation.

**Manitoba.**

DAUPHIN.—Steel laying and driving piles for the bridges on the Ste. Rose branch of the C.N.R. east of Ochre river was commenced on October 13th, by the Mackenzie and Mann Construction company. This work will be rushed to completion before the winter. The first regular train service was inaugurated on October 14th, on the Hudson Bay line of the C. N. R. This service will be weekly from Hudson Bay Junction to the Pas Mission, the present end of the steel which is 90 miles north of Prince Albert.

WINNIPEG.—Chief Engineer Schwitzer, of the C.P.R., stated a few days ago that the new branch line across the prairies from Saskatoon to Wetaskiwin will be completed in less than a week. There is but sixteen miles to lay on this

stretch, which is 330 miles in length, and which has been under construction for the past two years. The new line runs parallel with the G.T.P. and C.N.R., and opens up a fine stretch of country, which already is well settled.

WINNIPEG.—The active work of locating the line of the Hudson Bay Railway has begun. Mr. W. J. Clifford, with a large party have commenced work at the Pas Mission. Other parties will be sent out later. It is the intention to push the location line as fast as possible. The parties will work out all the winter, and supplies will be transported by dog trains.

**Alberta.**

EDMONTON.—The Great Waterways Railway has made an actual start on the work of locating a line from Edmonton to Fort McMurray, 400 miles. On Saturday last sixteen surveyors were sent out, and they will commence operations about 15 miles north of the city.

EDMONTON.—Mr. C. R. Stovel, right of way agent for the C. N. R., was recently in the Stettler district, to obtain right of way for the line from Vegreville to Calgary. The grading from Camrose to Stettler is practically completed.

**British Columbia.**

VANCOUVER.—Winter weather notwithstanding, the work of surveying for the transcontinentals now entering British Columbia is to be pushed with vigor during the next few months. A Grand Trunk Pacific party is in the territory between Nicola Lake and Kamloops, while the Canadian Northern outfit, which has been on the North Thompson all summer, is preparing to push on from Cranberry Lake. Another party will work in the Yellowhead all winter for the same company.

VICTORIA.—Mr. H. Fry, representing the British Columbia Government, and W. J. H. Holmes of the E. & N. Railway Company are in charge of parties which have been sent out to re-survey the northern boundary of the E. & N. railway lands.

NELSON.—The street railway by-law was carried almost unanimously. The company's plans as to initial equipment and extension comprise: Motor generation set, including sheds, switchboard and necessary cable from substation to trolley mains, $11,000. Two double-truck four-motor cars and two trailers, $12,000. Car barns, machine shop and full line of repair parts, $2,500. Rotary broom and apparatus necessary to attach same to core, $1,200. Belt line extension, $16,000. Total, $43,700.

VICTORIA.—Track-laying on the Alberni line of the C.P.R. is being rushed. The branch has been graded to a point about five miles beyond French Creek, and by the end of the year the company hopes to be operating trains to Cameron Lake.

## CEMENT—CONCRETE.

**Ontario**

THOROLD.—Messrs. Battle will shortly erect a building here for the manufacture of concrete blocks.

**Manitoba.**

WINNIPEG.—The Manitoba Gypsum Company are pushing ahead with the construction of their new plant. The main building is 66 × 160 feet, of reinforced concrete and brick. The plant will, on completion, afford another evidence of the progress being made in substantial buildings for the manufacturing industries of Winnipeg.

## TELEPHONY.

**British Columbia.**

PRINCE RUPERT.—The G.T.P. will install an up-to-date telephone system here shortly. Mr. A. B. Smith, manager of the Telegraph Department, is making arrangements.

## LIGHT, HEAT, AND POWER.

**Ontario.**

OTTAWA.—The power house of the Hull Electric Railway Company on Lake Deschenes was destroyed by a fire on Tuesday, October 19th, which damaged the plant. The street car service has been temporarily suspended, but arrangements are being made with the Ottawa Electric Company for a temporary supply of power.

**British Columbia.**

VICTORIA.—Messrs. Sanderson and Porter, of New York and San Francisco, represented by Mr. R. Carpenter, have charge of the installation of the 10,000 horse-power electric generation plant which is being erected by the British Columbia Electric Railway at Jordan River, near here, at an approximate cost of 1½ millions. The company expects to have the work completed in 18 months.

## FINANCING PUBLIC WORKS.

Debentures were recently sold by the following municipalities:—

**Kingston, Ont.**—$33,400 local improvements.
**Niagara Falls, Ont.**—$6,426, sewers.
**Osgood, Ont.**—$4,429, drainage.
**Guelph, Ont.**—$20,000, sewerage.
**Unity, Sask.**—$8,000, local improvements.
**Manor, Sask.**—$3,000, sidewalks.
**Saskatoon, Sask.**—$68,250, local improvements.
**Amaranth Township, Ont.**—$7,800, bridge.
**Nelson, B.C.**—$10,000, local improvements.
**St. Boniface, Man.**—$100,000 local improvements.
**Hamilton, Ont.**—$80,000, schools.

**Ontario.**

EAST TORONTO.—The Township of Scarboro unanimously passed a by-law to raise $16,000 by debentures for a school building and site north of Munro Park, Toronto.

GALT.—A by-law to provide $5,000 for water-works extension was defeated by a vote of 84 for to 98 against. This is the smallest vote registered in the history of the town.

GODERICH.—The by-law to guarantee the bonds of the Good Roads Machine Company, of Hamilton, to the extent of $40,000 carried by a substantial majority.

LONDON.—A by-law for storm sewers will probably be submitted at next election here.

OWEN SOUND.—A new addition will be built to the General and Marine Hospital, costing $12,000 or $15,000. The town council have passed a resolution authorizing the raising of $400,000 for a railway, either by creating a debenture debt or by guaranteeing bonds.

PETERBOROUGH.—A by-law for a new hospital to cost fifteen or twenty thousand dollars will be submitted to the ratepayers at an early date.

PORT COLBORNE.—Waterworks and electric light extensions whose estimated cost is $2,600 have been sanctioned by the town council. Debentures will be issued.

SALTFLEET.—This municipality will issue $9,000 debentures for cleaning drains.

**Manitoba.**

HAMIOTA.—Tenders are invited until November 5th by Joseph Andrew, secretary-treasurer of the municipality, for $13,000 telephone debentures.

**Saskatchewan**

YORKTON.—High school debentures amounting to $16,000 will be voted on by the ratepayers of Yorkton.

MOOSE JAW.—Mr. J. W. Sifton, secretary of the municipality invites tenders for $25,000 school debentures, until 26th October.

SASKATOON.—The by-law to provide $18,000 for a footbridge at Twentieth Street will be voted on on November 18th.

**Alberta.**

CALGARY.—The Langevin bridge by-law, for a 30-foot bridge over the Bow River at Fourth Street East, was sanctioned by 237 for to 13 against.

STRATHCONA.—Raymond R. Houghton, secretary-treasurer of this municipality, invites tenders for $15,000 telephone debentures, until November 1st.

**British Columbia.**

NELSON.—The street railway by-law was carried practically unanimously, and the company will shortly be placing orders for equipment.

NEW WESTMINSTER.—The ratepayers of Richmond have passed by-laws to raise $350,000 by a debenture issue. The sum of $275,000 was asked for waterworks extensions, of which $150,000 is for a distributing system, and the balance will be paid the City of New Westminster for a main

and joint system from Coquitlam Lake. The sum of $75,000 was also asked for road improvements.

VANCOUVER.—The Burnaby Council have passed the by-law allowing the British Columbia Electric Railway to construct and operate a line through the municipality from Hastings Township to New Westminster. The line is to run from Boundary Road along the south side of Burnaby Lake to the North Road and through to New Westminster.

## MISCELLANEOUS.

**Quebec.**

MONTREAL.—Improvements to streets and other works, estimated to cost $33,665, have been authorized by the council. The work will be done by day labor.

**Ontario.**

OWEN SOUND.—Mr. R. McDowall, C. E., has estimated the cost of constructing a drydock here, at $225,000.

CHIPPEWA.—Favorable progress is being made on the buildings which are being erected here by Messrs. Fitzgerald and Bennie.

## CURRENT NEWS.

**Ontario.**

WELLAND.—Mr. D. H. Philip, C.E., of Ottawa, Mr. R. Chatfield Ross, of Pt. Robinson, and Mr. Wm. Hoff, of Chippewa, are at Welland. They will make surveys in connection with the proposal to raise the level of Lake Erie. Estimates of land damages are being prepared.

**Quebec.**

MONTREAL.—A merger has just been consummated between the Rhodes, Curry Co., of Amherst, N.S., the Canada Car Co., and the Dominion Foundry Company, of Montreal. Mr. N. Curry of Amherst will be general manager of the company, whose capital will probably be $8,500,000.

## PERSONAL NOTES.

MR. J. W. CALDER, B.A. Sc., formerly of Blyth, Ont., is now located at Guelph, Ont.

MR. A. B. WALKER, formerly with the Canadian Fairbanks Company, is now with H. W. Petrie Co., Limited, of Toronto and Montreal, in the machinery department.

MR. ROBERT CREELMAN, formerly commercial agent of the Canadian Northern Railway, was last week appointed to the position of assistant general passenger agent.

MR. L. MERRIMAN, consulting engineer, of Chicago, who was recently in Regina looking over the waterworks, has been appointed by the Town of Dauphin, Man., to outline a scheme for waterworks there.

MR. KICKI KOBORI, M.E., chief electrical engineer of the Nji River Electric Company, at Kyoto, Japan, was at Niagara Falls last week inspecting the works of the power companies, with a view to gathering information as to the installation and operation of power plants. His company will construct the biggest plant in Japan.

## OBITUARY.

MR. GEO. TAYLOR, a well-known railway contractor, died at Brockville, Ontario, on October 13th. Mr. Taylor was a former traffic manager of the Canada Atlantic Railway, and built many sections of the Grand Trunk, Canadian Pacific and Intercolonial Railways, and also a part of the Soulanges Canal. He was unmarried, and 58 years of age.

MR. E. ELSTNER FISHER, until a few weeks ago, general manager and chief engineer of the T. H. & B. Railway, Hamilton, Ontario, died on Wednesday, October 13. Mr. Fisher was a member of The Canadian Society of Civil Engineers, and has been connected with the T. H. & B. in the capacity of general superintendent since the road was built, fifteen years ago. He was educated at the United States Academy at Annapolis and before beginning his railroad career held a commission as lieutenant in the United States navy. Later he was resident engineer with the Pennsylvania road, and then joined the staff of the New York Central, leaving that road to become superintendent of the T.H. & B. He soon made for himself a reputation as a thoroughly efficient railroad man, and under his management the T. H. & B. Railway became a very popular line. He also showed a fine public spirit, ever ready to give his assistance to any movement for the benefit of the city of his adoption. He took a prominent part in athletics, and was a lover of every honorable sport. Personally he was clear sighted, honest, far seeing and enthusiastic, and made friends easily. He was 56 years of age on Sunday last.

## LATE CONSTRUCTION NEWS.

### RAILWAYS—STEAM AND ELECTRIC.

**Ontario**

COBOURG.—The Toronto & Eastern Railway, through Mr. F. L. Fowke, M.P., will apply for a charter to build an electric railway from Cobourg to Toronto, via Bowmanville, Whitby and Oshawa.

LONDON.—The South-Western Traction Company's line, running between London and Lake Erie at Port Stanley, was sold by auction on October 20th, to Mr. J. E. McDougall, of London, representing a syndicate of London, Toronto and Hamilton capitalists. He paid $455,000 in cash and assumed $80,000 indebtedness, the total price being $555,000 above the reserve, C. C. Giles, Montreal, the next highest bidder, running it up to $450,000 and $80,000 debt. Mr. Giles, represented the bondholders, the majority of whom live in Edinburgh, Scotland. The London Street Railway Company, of which H. A. Everett, Cleveland, is president, had a cheque in for $350,000.

The Chicago, Milwaukee & St. Paul has ordered 250 all-steel passenger cars, of which 160 are for the western coast extension and 90 cars to be used on the old lines. The St. Paul is the first western line to place a big order for the expensive steel cars of the non-telescoping type. The Harriman lines have recently ordered 600 such cars and the Pennsylvania road in the east was a pioneer in buying 500 cars of the improved kind.

## MARKET CONDITIONS.

The market for pig-iron, especially for steel making iron, continues very strong in the United States. Bessemer grades have advanced 50c. per ton during the past week, as a result of the very heavy turnover. Basic grades have been liberally dealt in, the advance being about 25c. per ton. Foundry grades are not quite as active as during the previous few weeks, but there is still a large turnover at firm prices. English iron is commencing to come in at Atlantic coast points and this has a tendency to prevent further advances in prices of domestic grades in that section. On the whole, the market has a very healthy tone, not only for pig-iron but for all classes of iron and steel material, the feeling amongst the trade being strongly in the direction of gradually advancing prices and a continuance of good orders. The railway systems are not only placing heavy rail orders but have come into the market with several large orders for locomotives, cars, etc., thus materially strengthening the market.

England and Europe continue about as before, the tendency of prices being in the upward direction. Advances, however, have been immaterial, save on pig-iron, manufactured articles being sold for prompt shipment at prices which have prevailed during the past two or three months. The tendency is, however, to ask higher prices for future deliveries.

Locally, the market is in excellent condition, not only as to prices but also as to the tonnage changing hands. Makers are heavily booked ahead and are being pressed to take on further orders. Prices are advancing, and the likelihood is that next year will see them considerably higher, as costs and material will be dearer than they were the present year. It is expected that iron ore prices will be advanced at least 50c. per ton, which is $1 or more per ton on pig-iron.

Coke prices have shown an advance of at least $1 per ton, which will add another dollar to pig-iron, besides which, dealers are face to face with a further reduction in government bounties, which will add practically $3 to the cost of production of pig-iron in 1910, as compared with 1909. Makers will naturally desire to recoup themselves for this additional cost and consumers will be compelled to pay higher prices.

The markets for finished and semi-finished products were all very steady again this week, as will be seen from the following list —

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll, dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal.—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double streagth fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for 1/8, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ⅝-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5/16 x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 400 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¼ to 6c.

Toronto, October 21st, 1909.

In metals and hardware warehouses business has increased in volume. The demand for steel and iron is strong, and prices are firm all over the list. Such heavy merchandise as iron pipe, boiler tubes, black sheets, and galvanized iron are now in seasonable request by country manufacturers. We have not made many alterations of price, only nails and spikes, galvanized sheets and a few other items. An advance in iron pipe was noted last week; it is far from improbable that a further advance will come, so that the present is a rather inviting time to buy such goods.

United States advices show great activity in demand for railway rails, which cannot be overtaken for months because steel mills are behind in their orders. "The billet, bar, plate and shape mills have failed to keep pace with the finishing plants. * * * The capacity of the country, apparently, has broken down in the middle (October 17th), for pig-iron and coke are still to be had, while billets and steel bars cannot be bought, even at a premium, for prompt delivery."

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite**, per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—The expected advance has come; we now quote, black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $2.0; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.0c. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—An improved request is noted lately, at catalogue prices before quoted.

# The Canadian Engineer

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## The Canadian Engineer

ESTABLISHED 1893

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## PUBLIC COMPETITION.

A Canadian municipality is calling for competitive designs for a large public work.

It is to be hoped that professional men will set themselves against such methods of securing plans and specifications. For a thousand dollars the municipality will secure three thousand dollars' worth of information, and a large number of men will work up good plans, spend much time and energy, and will not receive one dollar.

A certain amount of competition may be necessary to keep alive and bright any body of men, but when it comes to working for months for nothing—sometimes even to have your plan or design stolen, great injury is sure to follow.

Municipalities should select their consulting engineer or architect and allow him to work out the best possible solution of the problem. Anyone of a dozen of the leading engineering firms could give this municipality a more workable and suitable plan than they will get in a competition.

If this municipality asked six firms to build six sections of sidewalk, promising to pay the firm that did the best work for one-half of all work done, how many firms would do work for them?

The scheme of competitive plans is just as unreasonable as this.

Engineers would do well to set their faces against a continuation of such practices.

## THE GRAND RIVER IMPROVEMENT ASSOCIATION.

It is to be hoped the organization of the Grand River Improvement Association will stimulate other sections of Canada to take an intelligent interest in such matters as the prevention of stream pollution, excessive runoff, and the beautifying of our river valleys.

The idea of such organizations is a good one, and Mr. W. H. Breithaupt, C.E., is to be congratulated upon having been successful in persuading the people along the Grand River to unite in an endeavor to investigate the causes of pollution and flooding, and assist in remedying undesirable conditions.

There are many streams in our older settled districts that years ago were fairly regular in flow and pure in water supply that are now sources of danger to the community, and the stream valley very unpleasing to the eye.

Such associations as this is will very much improve conditions, and we hope more will be organized. Mr. Breithaupt has done a great public service in educating the people in the neighborhood of the Grand River as to the possibilities of that stream, and his work there will be felt all over Canada.

## SERVICE OUR AIM.

A publishing house can find no end of branches which it may exploit in the hope of finding new and profitable business. Many departments are opened with that object in view. Not so this new department of The Canadian Engineer—the Information Department. It is opened solely with the view of giving quicker and surer information to employers and employees.

During the past year we have been able to furnish men for many different kinds of work in every part of Canada. If we had been provided with the information we could have placed twice as many men.

Then again, there are many men holding positions that are not to their liking. They do not hear of the openings, and when openings occur no one has a record of suitable men for the work. We hope to fill the want.

In a short time this department will have information that will make it possible to select a man for any vacancy. To-day we have four vacancies in different branches of engineering for which we cannot provide men because we have not a record of the men.

If you think we can help you, and you are an advertiser or a subscriber, let us send you a blank.

## THE BRITISH VIEW OF COLONIAL CONTRACTS.

(The Contractors' Record, England.)

A great deal of shouting has been indulged in concerning the work which ought to be secured by contractors in this country from the colonies, but whilst obstacles exist, rendering it almost impossible for proper tendering, very little real benefit is secured, except, possibly, to those who do the shouting. Proofs continue to reach us of the need for more time in which to tender upon large contracts. We refer more particularly to important municipal and Government work. Possibly there are many who find that in most cases the usual time limit is amply sufficient for their own purposes. With such, these considerations will find little favor. There are different ways of looking at every case. Probably these firms are either right on the job, or have little difficulty in getting a representative there. But what about the men who depend upon the press for their advice of contract work to be done in the colonies? There is very little chance for them within the limits already allowed for tendering. In the course of a season, for instance, great quantities of cast-iron and other pipe and all kinds of materials are needed by the various municipalities throughout, we will say, Canada, in connection with waterworks, sewerage, and general improvement work. To whom are these contracts generally awarded? In most cases to Canadian or American firms. Now, in these competitive days, when it is a maxim in municipal as in individual affairs, to get the best value at the lowest cost, it is manifestly unfair to bar any good competitor by not giving him sufficient time to tender. It is poor consolation for the British competitor, for instance, to know that he can get his goods into the country upon more favorable terms than the American manufacturer, and be forced to realize at the same time that in ninety-nine cases out of a hundred he is handicapped right out of the running by inability to deliver his tender within the specified time. There is a certain amount of humor in the situation, but there is something far more unjust in it than there is funny. Of course, there is but one sequel, in so far as the British contractor is concerned. He gives up all idea of tendering on Canadian work. We contend that any work which involves the expenditure of a large sum of money should be advertised within such a duration of time as to allow British firms to make some investigation, and submit a proper estimate. Inadequate notice of projected work means limited competition, ill-considered estimates, and many other resultant evils, apart from the injustice perpetrated on the long-suffering individual who foots the bill.

## BOILER EXPLOSION.

On the evening of October 12th the boiler in the Aylmer electric light and water plant exploded and wrecked the plant, spreading fire into the adjacent buildings. The engineer in charge was killed.

The boiler, which was of a hundred horse-power, and was situated at the west end of the building, had been recently overhauled and was inspected a week or two ago. This was the first time that it had been used since it was renovated.

The wreck of the building was complete. When the explosion occurred the boiler was literally torn in two. The

**Building and Boiler after the Explosion. This 4,000 Pounds' Boiler thrown 300 Feet.**

western half went through the side of the building, and was carried over a hundred and fifty yards, completely demolishing the footbridge across Catfish Creek. The other half flew through the east end to a distance of three hundred yards. A piece of the boiler struck the top of the standpipe of the waterworks, knocking it off. The loss will be about $35,000.

At the inquest the chief witness was Mr. F. Mitchell, of the London Engine Supplies Co., who gave expert testimony. He said there had been no burning of the flues or any part of the boiler. There had been no low water, and the explosion, in his opinion, had been caused by a weakness in a plate, which was cracked. There were two boilers in the plant, and they were used alternately. This meant that this boiler would be hot and cold by turns, and the constant contraction and expansion had aggravated the original trouble. Also, the crack in the boiler was situated underneath a spot

which the boiler inspector, making his semi-annual inspection, would be unable to see.

Chief Electrician Millard said he had examined the boiler on October 5th last, and that it was then in good condition. It was carrying 80 pounds of steam, and any repairs made were of a simple nature.

In returning their verdict the jury place no blame upon anyone. The explosion had been caused by a defect in the boiler, which could not be seen unless the whole boiler was taken to pieces.

## THE HISTORY, DESIGN AND CONSTRUCTION OF ELEVATORS.*

J. H. Shales.†

There are several designs of elevators, but only three types operated by either steam, water or electricity, steam being the earliest power used in the lift, as it is called in the old lands. The first used for passenger service was at the Crystal Palace in London about 1851, it being a very crude affair, with chains instead of wire cable from drum to car. The first hydraulic machines used in America were invented by the late Charles Otis about thirty-five years ago, from which we have the different designs now in use, and of which the plunger is the best.

By way of explanation, a plunger elevator is a new thing for the skyscraper. Yet it is the oldest kind of elevator in the world, but very few engineers ever thought it would be introduced into the twenty-storey office building. After having been proved a great success in other cities, it is coming to New York very fast. The method of boring the shaft is one of the marvels of the modern engineering age.

A shaft is started by setting up a short section of compressed steel piping. This is notched on one end, like a saw blade. It is attached to an electric motor and set revolving. As it cuts down into the earth steel shot are poured down and allowed to settle around the saw teeth on the end of the steel piping. A stream of water is then forced down to assist the grinding, and gradually the revolving pipe, with its saw-like teeth, assisted by the steel shot, bore deep into the earth. The hardest stone can be penetrated. In fact, any hard substance can be cut through with apparent ease. When the first section of piping has been sent down another is screwed on, and so the circular shaft is sunk. The core, whatever it may be—stone, clay, sand or water—comes up through the piping or caisson and is carried away.

It was while sinking one of these shafts the Otis Elevator Company encountered at 47 Maiden Lane, where the S. F. Myers building is in course of construction, a very thick layer of hard granite. When the core was finally pulled out of the caisson it was found to be 16 feet long. This is the longest solid rock core ever taken out in Manhattan, and it goes to show that the thickest layer of rock forming the foundation of Manhattan Island is in the down-town district of New York.

The Standard Elevator Company have eleven plunger elevators in the Trinity Building. These are the longest plunger elevators in the world. Eleven shafts, each 285 feet, have been sent down below the graves in Trinity Churchyard. They are used to support the cars of elevators which supply the big office building, and if they prove successful the superiority of the plunger elevator over the cable elevator will probably be established not only to the satisfaction of the engineers, but to the capitalists who furnish the money to build the modern skyscraper.

There are two designs of elevators that cannot be overlooked: First, the Sprague screw machine, which is in common use; and second, the Duplex or Fraser differential elevator.

The former is much like the horizontal hydraulic machine in operation, having no drum. The motor revolves on a long screw, on which travels a ball nut, and this nut moves the travelling sheaves. The operation of this elevator is very smooth, but the cost of repairs has to a large extent prevented its success.

The Duplex machine, on the other hand, might be said to be in its infancy, as only a few of them have been installed so far. It consists essentially of two motors, mounted one above the other, each having a driving pulley or sheave on the end of its shaft, around which the driving ropes run. The car is suspended from cables, which, after passing over the main overhead sheaves, are attached to the counter-weight. From the top of the counter-weight frame ropes are carried over another overhead sheave and down to counter-weight device, on which is mounted the tension sheave. The driving ropes run from the upper driving sheave over a sheave attached to the bottom of the counter-weight, thence around the lower driving sheave and over tension sheave and back to upper driving sheave.

The driving ropes are continuous, and as long as the two motors run at the same speed the various sheaves revolve in their places and the car stands still. As soon as the relative speed of the motor changes, the counter-weight is raised or lowered, and the car moves correspondingly. This kind of elevator can attain the high speeds of the hydraulic elevators, as the motors are not stopped in stopping the car. The car-switch controls two rheostats, one in the field of each motor, and the field of one is weakened while the other is strengthened as the car-switch moves away from the central position. In the central position of the switch both fields are alike, and the motors run at the same speed. The ease and rapidity with which these elevators are started and stopped is wonderful. In this respect they are superior even to hydraulic elevators. Of course, the continuous operation of the motors means a greater power consumption, but this is largely offset by absence of starting current and the time saved in handling passengers. You may notice that I have not mentioned either automatic residence elevators or alternating current elevators, but the omission is intentional. The automatic, with push-button control, offers an interesting study, but is used, of course, almost exclusively in private houses, and hence you would have no occasion to deal with it.

In regard to alternating current elevators, there are some inherent faults which have not yet been overcome.

In an office building which I visit there is an alternating current elevator, which manages to keep running and carry passengers, but the tenants all know when it starts. It emits first a low groan, which rises rapidly to a high-pitched humming sound, and maintains this until the car stops.

Of the first importance in connection with elevators are the safety devices. On the high-grade drum type machine we have, first, the main brake, which is raised by a solenoid, and consequently acts not only when released from the car-switch, but whenever current fails from any reason what-

* Read before the Central Railway and Engineering Club, Toronto.

† Consulting engineer, Elevator Specialty Co., Toronto, Ont.

soever. Second—We have the stop motion switch, which is operated by a travelling nut on an extension of the drum shaft, and stops the elevator at either limit of travel by means of a switch, which is practically a duplicate of the car-switch. Third—The potential on the controller, which opens and cuts off current if the line voltage drops or whenever the slack cable or limit switches open. It is also operated by the car-switch as heretofore described, and similarly by the stop motion switch. Fourth—The slack cable switch is usually located underneath the drum, and is opened mechanically whenever one of the cables becomes slack. This opens the potential switch circuit, stopping the machine. Fifth—Limit switches in shafts are so placed as to be opened by the car when it exceeds its normal limit of travel. They open potential switch circuit as before described, and act as a check on stop motion in case it gets out of adjustment. Sixth—Safety switch in car, which opens operating line, and hence potential switch, and shuts down elevator. This is for the benefit of the operator if car-switch should stick.

Where an emergency brake is used, safety switch operates this. Seventh—An auxiliary emergency brake is used on large machines, which acts when all circuits are opened from car-switch or main current fails. This gives increased mechanical braking at a time when dynamic braking action would fail. Eighth—Car safety, which is controlled by centrifugal governor and grips rails, stopping car at any predetermined speed.

The best form consists of a ball governor at top of the shaft, which grips governor rope at excessive speed. Governor rope is attached to car by a spring plug, which pulls out readily. A second rope is fastened to governor rope and then wound round the drum of the safety plank. When the governor rope is gripped, this rope unwinds the safety drum, and by means of right and left screws and toggle joints or wedges forces jaws of safety together until they cramp the rails hard enough to stop the car.

The governor sometimes operates a switch to stop the motor before grips go on. Ninth—An air cushion is sometimes used as a last resort, if everything else fails. Tenth—Slow-down switches in shaft are often used. They may automatically cut in an auxiliary shunt, winding on the motor as the car nears the upper and lower landings, so that limits of travel are approached at slow speed.

Although so many safety devices are required, they are comparatively simple in themselves and positive in operation. The general cause of accidents is the abuse of or neglect to care for them. Of course, you all know that trouble and accidents have occurred on all makes. It may be worth while to discuss them briefly and the means of prevention.

In the first place, there are a great many contacts about the controller of an electric elevator, and it is essential that they be kept clean and in proper adjustment. Contact pieces that have to carry heavy current should have ample bearing surface, and where such contacts are used to break currents they should have auxiliary carbon contacts, between which the final break and consequent arc occur

In the controller of which I have spoken copper discs are used and set loosely on their spindles, so that they rotate during operation, and constantly present new surfaces to the contact pieces. A judicious use of emery cloth will keep these in order for a long time. Knife contacts, however, are very bad I remember one time when I was called in to investigate an elevator accident. The controller was a cheap solenoid affair, with a double lever arrangement. The car rope turned a shipper sheave, which moved a lever and threw in the main switch, which in turn connected the solenoid and started the motor, the solenoid gradually cutting out the resistance. The switch blades happened to get bent and passed their clips, making a poor contact. The arcing set up fused the blades solidly to their clips, and the operator could not pull hard enough on shipper rope to release them.

The car came on down to the bottom, and as soon as the ropes slacked the mechanical slacked cable device was brought into play. This merely threw a clutch into gear with a pinion, meshing with a rack on the same old lever, and, as the switch blades still refused to let go, the gear was stripped of its teeth, the lever bent and the controller board smashed. The main line fuses blew out at this point and saved the rest of the wreck.

There were two bad features in that elevator: knife contacts and a mechanical slack cable device. The remedy prescribed was a new and better controller. Great care should be used to keep wires from becoming crossed or grounded, as almost any combination of circuits can be obtained by grounding wires, and it is impossible to foretell the result.

I know of one case where an armature grounded and a sudden flash occurred clear across the commutator. The startled attendant grabbed a fire bucket and threw its contents on the motor. It put out the fire, but it pretty effectually put the motor out of business and cost a new armature.

Another thing: If you disconnect the field terminals, be sure to get them back right. If you get the series field in opposition the motor will surely run away. Even a loose connection in the field circuits may cause trouble.

It is well to remember, too, that the car is overbalanced for the sake of economy, and if you jack the brake off while making some repairs, and at the same time have the main switch open, the car had better be at the top of the shaft; otherwise it will soon get there, and it might not stop at the roof.

A great many accidents in which people have been hurt have been due to the car over-running the lower limit and breaking the counter-weight ropes at the top of the shaft and dropping the weights on the people below, when they would not otherwise have been hurt. This is easily prevented by having the weights securely bolted together by through bolts.

Sometimes hoisting ropes break and the car safety fails to operate. This cannot occur with a good governor, kept in proper condition. It would seem superfluous to say that all moving parts should be kept clean and well lubricated, and yet most of the wear and tear and a great deal of trouble is due to just this lack of attention. All the cables, but particularly the hoisting ropes, should be carefully inspected frequently, and if the wires of the latter show signs of cracking the ropes should be discarded. If they show wear on one side, observe how they lead from drum to sheave, or in case of B.D. ropes, from drum to vibrator. See that the vibrator shaft is so clean and well lubricated that the vibrator follows easily and does not lag behind, pulling the ropes off to one side.

I will touch on just one more point. The electric elevator in small buildings offers marked economy over other forms. No steam plant has to be run for its benefit, and it uses power only when it is in operation, and then proportionately to the load carried. With average load, it takes only the power required to overcome frictional and motor losses. In general, you might expect an automatic residence elevator to use about 1.6 k.w.h. per car mile, and a big passenger machine for a large office building about 3 k.w.h. per car mile.

The Duplex machine has not been thoroughly tested, but while using about the same current in operation, undoubtedly averages somewhat more, due to its constant running motors.

## THE VALUE OF EXPERT INVESTIGATION.

Reference has frequently been made to the good work accomplished in the exposure of graft by the original Boston Finance Commission, which recently completed its labors. Hon. Nathan Matthews, chairman of that Commission, has, however, pointed out that this part of the work was incidental only to the real work of the Commission, namely, the investigation of the conditions, facts, costs and methods which have made the city government of Boston the most expensive in the world and one of the least efficient. The service rendered by this Commission is indicated not so much by public hearings and disclosures of graft as by the two hundred odd reports submitted by the Commission and its engineers to the city government. Whatever may be the permanent value of this work, it at least differs from that of other municipal investigations in being a detailed study and criticism of actual methods, conditions and facts.

The Commission in the beginning recognized the necessity and great value of expert investigation, upon which its general conclusions might be based. They were fortunate in securing the services as consulting engineers, of the firm of Metcalf & Eddy, of Boston, whose fifty-nine reports in the form of a volume of over 1,200 pages have just been published. Especial value is given to these reports by the standing of the firm by which they were made.

It is manifestly impossible to present in a few words the results presented in such a stupendous piece of work, but a few examples cannot fail to be of interest. The magnitude of municipal waste is manifest in the estimate of the experts that in 1908 the losses resulting from the carrying of unnecessary employees, the performance of work which should have been done by contract instead of day labor, the inefficiency of labor and improvident contracts were not less than $1,900,000 in five departments alone, the street cleaning and watering, sanitary, sewer, water and paving departments.

The sewer department spent $1,384,347 in 1906-7 and $1,240,709 in 1907-8. There was an utter lack of discipline over the employees, favoritism in the award of contracts prevailed, excessive prices were paid for contract work, and there was a further loss in the failure properly to inspect the work. Some employees had enough influence to procure reinstatement after discharge; others got transfers from strict foremen to lenient ones, and others procured positions which required no mental or physical effort.

The financial result of the construction work of the sewer department, as admitted by the superintendent, his chief engineer and his deputy, was a loss to the city of from 25 per cent. to 150 per cent. of the proper cost of the work.

For many years stone had been crushed by the department at an excessive cost. Between 1897 and 1906 the average cost of stone to the city at the crusher plants operated by the city was $1.60 per ton. In 1906 it was $2.85, and in 1907 it was $3.24 per ton. The fair market price, f.o.b. cars in Boston, did not exceed $1.10 per ton. Although the mayor had been advised by the executive engineer of the department to discontinue this work, he refused to do so, and the aggregate loss to the city in these two years from this cause was about $179,000.

The cost of laying pipe in the water department was found to have been from 50 to 150 per cent. in excess of the cost of similar work in neighboring cities. The cost of hydrant maintenance in winter was twice what it was in Brookline, and nearly twice as great as in Chelsea or Worcester.

It was shown that on a basis of $2,500,000 spent nominally for sewer or waterworks construction $1,750,000 is the fair cost of the work, and $500,000 in addition is spent for superfluous labor and $250,000 more in excess prices for contracts and purchases, entered into without competition with favored individuals. It is easy to see that all sections and classes of the community, laborers as well as property owners, are defrauded out of $750,000, or 30 per cent of the entire outlay.

## HOW BOSTON WASTED A MILLION DOLLARS.*

"It having been shown by the expert investigation of an independent engineer that the city stone-crushing plants had been operated at an annual loss of about $100,000, the Commission recommended their abandonment.

"But the subject was reopened by the mayor in a letter to the Commission, stating that 'at the behest of certain city employees, who professed their confidence at their ability to turn the present tide of extravagance in the operation of stone-crushers, I gave them a promise that for a limited time I should allow them the use of one crusher for experimental purposes . . . I shall appreciate the favor if you will have Messrs. Metcalf & Eddy detail an employee for special supervision of the work on the ledge, in order not only that we may both have information first hand, but also that there will be no question as to its reliability."

This request was immediately complied with. The best men in the department were selected to run a three months' test on the most economical plant owned by the city. Nearly nine thousand tons were crushed at a total cost, including interest and depreciation of slightly over $9,000, the unit cost being substantially $1 per ton. Independent records kept by Metcalf & Eddy and by the superintendent of the plant showed a nominal difference of only 2 per cent. in the cost.

Under efficient management the output of the crusher should have been 240 tons per day. The actual average during the three months' test was only half that amount, and this in the face of the fact that the men were the best that could be found in the department. Although the perpetuation of the crusher plant hung in the balance and the work was under constant supervision, even these incentives lacked the power to offset personal inefficiency, lax discipline, short hours, high wages, half holidays and absence with pay.

The original conclusions of the Commission were emphatically confirmed, and the folly of undertaking to crush stone by day labor employed by the department was clearly demonstrated by the fact that the cost per ton was nearly double that for which it could have been produced by a contractor under similar conditions. Thus the knell was rung for a policy that in a dozen years had entailed a loss of a round million dollars."

* From an article by Walter B. Snow in the "American City."

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8300 to 8302—October 8—Granting leave to the Consolidated Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. near Erin, Ont., and Hillsburg, Ont.

8303—October 8—Granting leave to the Manitoba Government Telephone system to erect, place, and maintain its wires across the track of the C.P.R. 1¾ miles south of Altona Station, Man.

8304 to 8308—October 8—Granting leave to the Wroxeter Rural Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. in the Tps. of Howick and Turnberry, Province of Ontario.

8309 and 8310—October 8—Authorizing the Municipal Corporation of the town of Clinton, Ont., to lay water main under the track of the G.T.R. at Matilda Street, and where the same crosses Victoria Street to London Road in said town of Clinton, Ont.

8311 and 8312—October 8—Granting leave to Dr. F. J. Weidenhammer, of Hawkesville, Ont., to erect, place, and maintain, wires across the track of the C.P.R. just west and south-west of Wallenstein Station, Ont.

8313—October 13—Authorizing the C.N.Q.R. to reconstruct trestle approaches of its bridge over the St. Maurice River near Grand Mere, P.Q.

8314—October 12—Granting leave to the G.T.P. to construct its railway across certain highways in the district of West Saskatchewan, Prov. Sask.

8315—October 6—Granting leave to St. Maurice Valley Railway to cross with its tracks the tracks of the C.N.Q.R. at Grand Mere, P.Q.

8316—October 13—Approving and sanctioning location of the C.N.O.R. through the Tps. of Goulburn and Marlborough, County Carleton, Ont., mileage 17 to 29.

8317—October 13—Authorizing the C.N.O.R. to connect the lines and tracks of its Udney-Orillia line with the lines and tracks of the Georgian Bay & Seaboard Railway Company at Atherly Junction, Ont.

8318—October 13—Authorizing the Corporation of the City of Montreal, P.Q., to lay and thereafter maintain water main under the track of the C.N.Q.R., where the same crosses Nicolet Street, Montreal, P.Q.

8319—October 13—Authorizing the Corporation of the City of Montreal, P.Q., to lay and thereafter maintain water main under the tracks of the C.N.Q.R., where the same crosses Valois Street in said city.

8320—October 12—Granting leave to the Consumers' Gas Company of Toronto, Ont., to lay and therafter maintain gas main under the tracks of the C.P.R. on St. Clair Avenue in said city.

8321—October 13—Granting leave to the C.N.Q.R. to erect, place, and maintain its tracks and telegraph wires under the wires of the Bell Telephone Company at Cap Rouge Station, County and Province of Quebec.

8322—October 12—Authorizing the Corporation of the City of Peterborough, Ont., to lay and thereafter maintain water main under the tracks of the C.P.R. so as to extend present main on Burnham Street to the premises of Peterborough Lumber Company in said city.

8323 to 8325—October 13—Granting leave to the Government, Province Saskatchewan, to cross the C.N.R. at one point and the C.P.R. at two points in the Province of Saskatchewan.

8326 to 8328—October 13—Granting leave to the Rural Municipality of Miniota, Province of Manitoba, to erect, place, and maintain its wires across the track of the C.N.R. at three different points in the said province.

8329—October 13—Granting leave to the Canadian Machine Tel. Co., Ltd. to erect, place, and maintain its wires across the track of the G.T.R. at Mount Vernon Station, Ont.

8330—October 13—Granting leave to the Manitoba Gov. Tel. system to erect, place and maintain its wires across the track of the C.N.R. Company at P.C. near Argue Station, Manitoba.

8331—October 12—Authorizing the town of Walkerville, Ont., to lay and thereafter maintain a sewer under the track of the Lake Erie & Detroit River Railway on Argyle Avenue in said city.

8332—October 13—Granting leave to the Manitoba and Saskatchewan Coal Company, Ltd., to erect, place, and maintain its wires across the track of the C.P.R. at Bienfait, Sask.

8333—October 11—Authorizing the G.T.R. to cross with its second track the track of the United Counties Railway at St. Hyacinthe Junction, P.Q.

8334—October 5—Directing that certain streets at St. Henri, in the City of Montreal, be protected by watchmen, to be appointed by the G.T.R.

8335—October 5—Granting leave to the C.N.O.R. to construct its line and tracks across the P.C. on Lot 26, Con. 1, Tp. Gloucester, County Carleton, Ont.

8336—October 5—Dismissing application of C.N.O.R. to connect its lines and tracks with the lines and tracks of the Manitoulin & North Shore Railway Company, in town of Sudbury, Ont.

8337—October 8—Rescinding Order of the Board No. 7343, dated June 23, 1909, by substituting for clause 2 of first part. Clause: "That on cheese shipped from points west of Montreal on separate rail bills of lading to Montreal, and which arrived at Montreal before the close of the season of St. Lawrence navigation then current, the railway companies absorb the Montreal wharfage and port warden's fees, provided the same cheese is exported from the port of Montreal not later than the 31st day of May of the following season of St. Lawrence navigation; the said absorption to continue xxx."

8338—October 15—Authorizing the G.T.R. to construct, maintain and operate certain branch lines in the City of Toronto, extending from a point in its Don yards, east of Trinity Street, across River Don and upon and along Cherry Street and certain other properties belonging to the City of Toronto, Ont., to and into the premises of the National Iron Works.

8339—October 14—Approving and sanctioning deviation in location of portion of the Edmonton & Slave Lake Railway Company through Tps. 56 to 60, R. 25, west 4th Mer., mileage 21.30 to 46.68, Alta.

8340—October 14—Granting leave to the Commissioners of the Transcontinental Railway to carry its railway at grade, across its existing highway near mile 3, from the north abutment of the Quebec Bridge, County Levis, P.Q.

8341—October 14—Granting leave to the City of Calgary, Alta., to erect, place, and maintain its wires (used for operation of Calgary Electric Street Railway) across tracks of spur line of C.P.R. at 2nd Street East in said city.

8342—October 15—Approving and sanctioning location of the G.T.P. from mileage 229 to 289, Cariboo District, Province of British Columbia.

(Continued on Page 486.)

THE
# Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWER DISCONNECTING TRAPS.

An important sanitary question with reference to house drainage (bearing on sewerage) is receiving a great deal of attention at present, viz., the advisability (or otherwise) of trapping the house drain from the public sewer.

Ten years ago the question would have received an emphatic answer in the affirmative. To-day, however, there are scores of sanitarians, who hold that any trap placed on the line of the house drain is a useless and objectionable obstruction to the flow of sewage, as well as a means of cutting off a desirable method of sewer ventilation.

In trapping a private drain from the public sewer it is usual to fix a syphon trap on the line of drain at a point before it connects with the sewer. There are many varieties of this trap on the market, the trap being essentially a bend in the drain below the mean gradient. Sewage is retained in this bend, thus cutting off all air communication between drain and sewer. Above the bend, on the house side of the trap, an air pipe is connected with the drain. This supplies an inlet for fresh air, the outlet being (generally) the projection of the soil pipe to above the roof of the building.

The chief advantages claimed for this system of trapping are as follows:—

(a) Isolation from the public sewer, thus guarding against the transmission of disease germs from house to houe by means of the sewer gases.

(b) In case of plumbing defects in connection with sanitary fittings, the air drawn into the building will be fresh air fouled only to the extent of contact with the short length of house drain.

These claims are based upon the assumption that disease germs are transmitted in sewer air—an assumption, however, which appears to have no basis in fact, as clearly shown by the experiments recently made by Prof. Winslow, published in the issue of this Review of August 25th last.

Apart, however, from the truth, or otherwise, of the theory of sewer air transmission of pathogenic germs, the sewer trap appears to be an apology for defective plumbing, which in any case should not exist If we grant the transmission theory, then in the case of a single outbreak of typhoid in a house with defective plumbing, there is no reason why the house drains and down pipes should not be a means of distributing the germs to the whole household. In any case, it would appear important that all sanitary appliances should themselves be trapped and allow of no drain air connection to the building.

The argument, however, may be used: "After all, the sewer trap is an extra safeguard and can do no harm." This brings us to the crux of the whole question raised against the sewer traps. Does it do no harm?

Again granting the sewer air germ transmission theory and defective plumbing requiring a sewer trap, so as to minimize the dangerous character of foul air leaks, we must ask the question, What of the sewer air itself? The insertion of a sewer trap to every house drain means the confinement of the sewer air to the sewers. If the ordinary method of ventilation be adopted, viz., by means of open manhole gratings in the roadway surface, then these germ-laden gases will be eliminated, when they will be readily breathed in by the outside public. On the other hand, if airtight manhole covers be adopted, then it will be necessary to provide at great expense to the community sewer ventilation by means of special pipes carried from the sewers to points of safety.

Is it necessary to incur this extra expense of special sewer ventilation as an excuse for defective plumbing arrangements, or would it not be better, from all points of view, to insist that just as much attention be given to sanitary fittings as to gas fittings to ensure against leaks.

The removal of the sewer trap means that every house soil-pipe will tend to act as a sewer air outlet ventilator, and that the open street manhole covers will act as fresh air inlets to the sewer. Sewer air being as a rule warmer than outside air has a tendency to rise and pass off at the highest points, drawing upon the lower openings for equilibrium of supply.

Apart from the transmission theory of disease infection by sewer air, it is acknowledged that the gas products of decomposing sewage are objectionable. Emanations of foul odors from street gratings are common causes of public complaint in most towns, especially at high levels. It would, therefore, appear that where the cost of special sewer ventilation bars its adoption, the most efficient method is to be obtained by insisting upon:—

(a) Efficient and airtight plumbing and house drainage.

(b) That the local building authorities test all drainage and plumbing fittings by some test, such as the smoke test.

(c) The non-adoption of any trap between the house drain and the public sewer.

(d) The utilization of all soil-pipes and house drain ventilators as sewer air ventilators.

(e) The utilization of street manhole gratings as fresh air inlets.

(f) That all soil-pipes and drain ventilators terminate well above the eaves of buildings and away from windows.

## SIZES, MATERIALS AND SHAPES OF SEWERS IN THE CITY OF HAMILTON.*

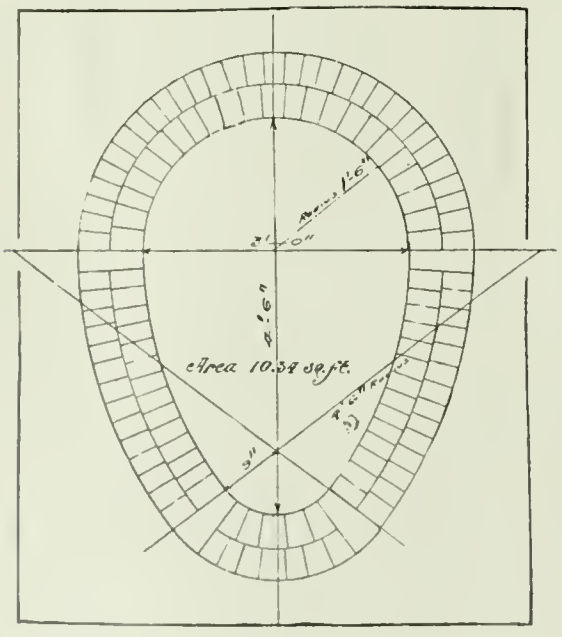
By E. C. Barrow, Hamilton, Ont.

It is at times interesting and profitable, especially for the municipal engineer, to take a peep backward into the early history of a city and carefully examine and consider the character of the engineering works constructed at the commencement of its existence, and then follow step by step the various changes in designs and materials which have taken place from time to time in accordance with the advancement made in engineering knowledge.

The object of this paper is not to give an account of the sewerage system of Hamilton, which would take more time than is at present at my disposal, but to describe the various forms and materials of sewers which have been introduced from time to time pointing out any defects which have been discovered, and stating also the cost of each particular class.

The first sewers built in Hamilton were commenced in the year 1852 and completed in 1857. They consisted of egg-shaped brick sewers, and were about 3½ miles in length. (At the present time there are 83 miles of sewers in Hamilton).

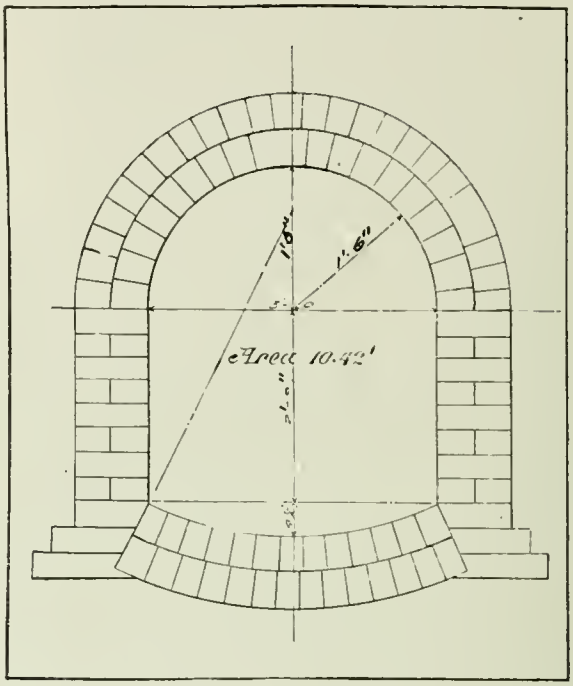
These brick sewers were mostly 4′ 6″ by 3′ 0″, as shown on the accompanying drawing. A small portion at the lower end was 5′ 6″ by 4′ 3″. The sewers on James and Catharine Streets were of the same size and area throughout their entire length, and of late years have become gorged at the lower parts and were totally inadequate to take storm waters. There is no record of how the size and area of these sewers was determined. The higher part is unnecessarily large and the lower part too small. They were built of brick with ordinary lime mortar. The top part, or crown of these sewers, as also the sides, are now in a good state of preservation, but the invert has been worn away and has had to be constantly repaired.




It is probable that the smooth surfaces now presented by cement walks and permanent roadways were not taken into consideration when the sewers were designed, and it is likely also that the higher parts were made large so as to admit of the passage of men through them.

*Read before the Ontario Land Surveyors.

The advantage claimed for the oviform shaped sewer is its adaptability for varying flows; i.e., when there is only a small flow the invert of an egg-shaped sewer gives the necessary scour and keeps the sewers cleaner than a round or a wall-sided sewer. Evidently the wearing at the bottom of this class of sewer calls for a harder material than ordinary sewer brick.




It is really wonderful, however, how well the top and sides of these sewers are preserved, being now 60 years old. It has been necessary to relieve these sewers by overflow sewers, and still, during extraordinary rainfall, they are occasionally gorged. The cost of these sewers was $5.10 per foot, and their average depth 13 feet.

The next form of sewer was what is called the wall-sided, and was introduced into the system by Mr. Haskins, City Engineer. The first sewer of this class was built in 1889 and formed the trunk sewer for the west end district. The egg shape form was discarded because the ordinary flow was fairly uniform and copious, and the inequality of flow for which an egg-shaped sewer is particularly suitable was not present in this case, and by the adoption of the new form a cheaper sewer could be built and the wear of the invert on the egg-shape sewer avoided. This sewer cost $5.01 per foot, and was about 12 feet 6 inches deep. It is in a good state of preservation, and the invert is not worn to any appreciable extent. Water lime was the cementing material used.

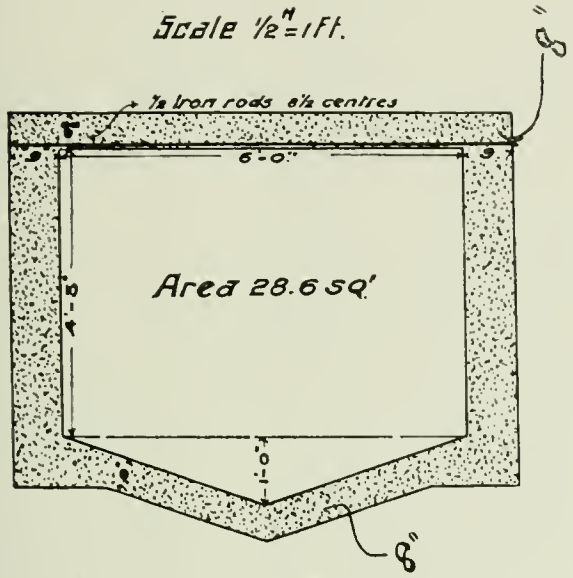
Vitrified pipe sewers were first laid in 1877, and the joints were made with clay. It was found that the roots of trees, especially the poplar, got into the sewer through these joints and clogged them. There was also a large leakage of sewage at these parts. The above defects led to the introduction of cement joints in the year 1895.

No vitrified pipe sewer larger than 24 inches has been laid in this city, and many engineers consider 15 inches as the largest size they would recommend.

The first concrete sewer was built in 1905 on Sanford Avenue, and was circular in form and 3 feet in diameter. It was composed of one part of cement, 3 parts sand, and 5 parts gravel. The lower two-thirds of the sewer was built in moulds placed in the trench, and the remaining part was constructed above ground in two-foot lengths.

The cost of this sewer was as follows:—

| | Cost per ft. |
|---|---|
| Labor moulding top 1-3 of sewer | $0.29 |
| Labor moulding 2-3 sewer in place | 0.98 |
| Materials— | |
| Cement, 1.31 bags | 0.655 |
| Cost of centres and moulds | 0.149 |
| Gravel, 0.215 cubic yards | 0.339 |
| Tools and repairs of same, tow, nails, oil, etc | 0.141 |
| Lumber | 0.195 |
| | $2.759 |
| Excavation 13 feet deep | 2.765 |
| Total cost per foot | $5.524 |




**Cross Section of Concrete Sewer on Trolley Street.**

This sewer, built in 1905, is the oldest we have of this material, and sufficient time has not elapsed to pronounce with certainty as to its superiority over brick.

The next concrete sewer was built in 1906 and was 3 feet 6 inches in diameter, circular in form, and constructed similarly to that last described on Sanford Avenue. A comparative cost of cement and brick sewers of same capacity is here given:—

**Cement Sewer on Catharine Street, Wood Street to the Bay, Built in 1906.**

3 ft. 6 in. diameter, 10 ft. 6 in. deep, and 1,465 ft. in length.

| | Cost per ft. | Total cost. | |
|---|---|---|---|
| Excavation, labor 20c. per hour | $1 63 | $2,389 61 | |
| Cement work, moulds | 1 19 | 1,745 60 | 2 06 |
| Cement, 2,091 bags at 50c. | 71 | 1,045 50 | |
| Gravel and sand | 16 | 233 75 | |
| Lumber | 09 | 137 48 | |
| Repairing tools, rubber boots, nails, oil, etc. | 06 | 82 13 | |
| Advertising and inspection | 11 | 164 30 | |
| Engineering Department, levels, stationery | 05 | 77 57 | |
| Manhole | 04 | 41 01 | |
| 1,465 ft. | $4 04 | $5,917 04 | |

Note.—Cement concrete sewer, 3 feet 6 inches diameter, without excavation. Cost, $2.06 per foot.

**Brick Sewer on Catharine Street, from Wood Street to Barton Street, Built in 1903.**

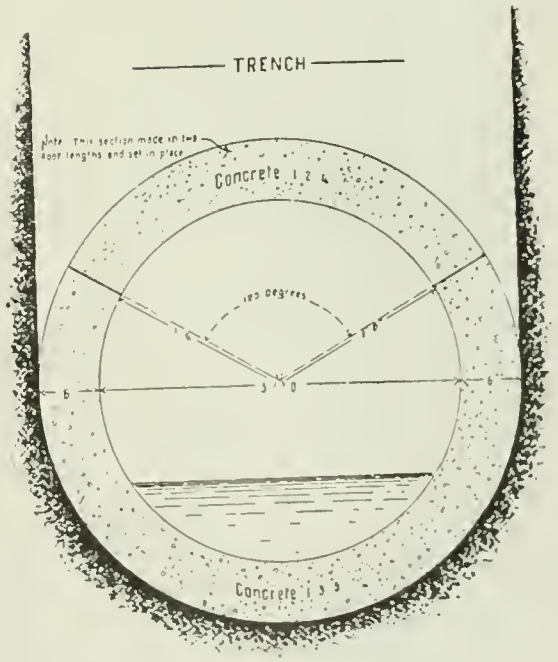
18 ft. deep and 2,933 ft. in length.

| | | Cost per ft. | Total cost. |
|---|---|---|---|
| Labor, excavating and filling, 18c. per hour | | $3.908 | $11,462 55 |
| Labor, brick work, 35c. per hour | | 0.738 | 2,165 81 |
| Brick, $6.90 per M. | | 0.895 | 2,625 93 |
| Cement, 50c. per bag | 2,205 | 0.468 | 1,374 55 |
| Sand and gravel | | 0.104 | 306 15 |
| Lumber | | 0.094 | 276 24 |
| Dynamite | | 0.02 | 60 80 |
| Tools, repairs | | 0.122 | 357 61 |
| Iron pipe | | 0.13 | 383 82 |
| Manhole castings | | 0.01 | 39 82 |
| 2,933 ft. | | $6.489 | $19,053 28 |

Brick sewer at current rates, same size, without excavation, would cost $2,757 per foot.

**Cost of Above Sewer at Current Rates for Wages and Material.**

| | Cost per ft. | |
|---|---|---|
| Labor, excavating and filling at 20c. per hour. | $4.30 | |
| Labor, brick work at 45c. per hour | 0.95 | |
| Brick at $9.50 per M. | 1.235 | |
| Cement at 50c. per bag | 0.468 | 2.757 |
| Sand and gravel | 0.104 | |
| | $7.057 | |

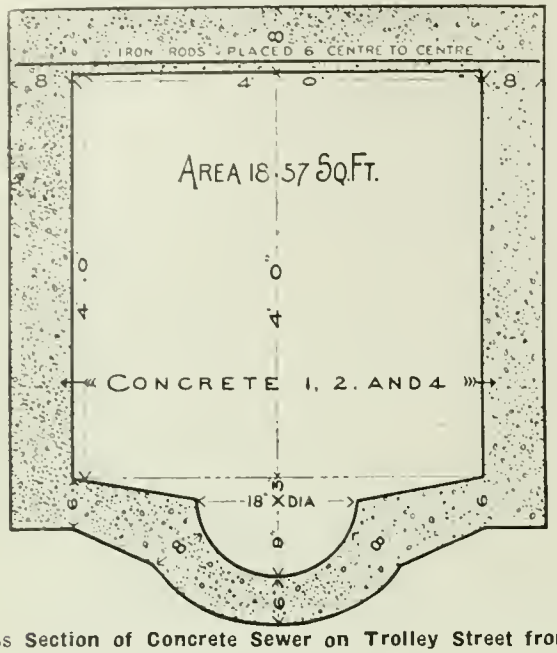



**Cross Section of Concrete Sewer, Sanford Ave.**

In 1907 a large reinforced concrete sewer was built composing the trunk sewer of an extensive district at the east end of the city.

For a large portion of its length this sewer had very little cover, and the following forms were designed to meet the existing conditions. The excavation was in very hard blue

clay and could be excavated accurately to the shape of the sewer. The large section cost $10 a foot and the smaller one $7.85.




**Cross Section of Concrete Sewer on Trolley Street from Barton Street to Beach Road.**
**Scale 1 in. = 1 Ft.**

The relative merits of concrete and brick as a material for sewers is now being debated somewhat hotly. Our cement concrete sewers have not been down long enough to judge of their durability.

The experience in Hamilton would be that no cast iron rule can be laid down with regard to the shape of a sewer, but a study of the surrounding circumstances and conditions will dictate the best form to be adopted.

## RAILWAY ORDERS.

(Continued from Page 482.)

8343—October 15—Authorizing the Corporation of the City of Peterborough, Ont., to lay and thereafter maintain a five-inch water main under track of the Lindsay Branch of the G.T.R. where the same crosses Park Street, Peterborough, Ont.

8344—October 14—Authorizing the village of Georgetown, Ont., to lay water main under the track of the siding of the G.T.R. to the Canada Coating Mills, Ltd., in said village.

8345—October 14—Granting leave to the Citizen Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. Company at first crossing south of Bromo, P.Q.

8346—October 14—Granting leave to the Citizen Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at second crossing west of West Shefford, P.Q.

8347—October 14—Authorizing the Sterling Gas Company, Ltd., to lay and thereafter maintain gas pipe under track of the G.T.R. between Lots 20 and 21, Con. 1, Tp. of Humberstone, Ont.

8348—October 14—Authorizing the United Fuel Supply Company, Ltd., to lay and thereafter maintain a pipe for conveyance of natural gas under the track of the G.T.R. on Lot 8, Front Con. of Tp. of Raleigh, County Kent, Ont.

8349—October 14—Granting leave to the Bell Telephone Company to erect, place, and maintain its aerial wires across the track of the N. St. C. & T. Railway at P.C. corner Welland Avenue and Francis Street, St. Catharines, Ont.

8350—October 14—Granting leave to the Citizen Telephone Company to erect, place, and maintain its wires across track of the C.P.R. first crossing west of West Shefford, Province of P.Q.

8351—October 9—Authorizing the C.P.R. to construct branch line across and along Hardisty Street, City of Fort William, Ont.

8352—October 9—Authorizing the C.P.R. to cross with its tracks the track of the Port Arthur and Fort William Electric Street Railway at Syndicate Avenue and connect its tracks with the tracks of the Fort William Terminal Railway & Bridge Company, Fort William, Ont.

8353—October 14—Authorizing the City of Wetaskiwin, Alta., to lay water and sewerage pipes under track of the C.P.R. where the same crosses Pearce Street, Wetaskiwin, Alta.

8354—October 15—Granting leave to the Volcanic Oil & Gas Company to erect, place, and maintain its wires under the track of the C.P.R. where the same crosses the Walker Road at Lots 96 and 97, Tp. Sandwich East, County Essex. Ont.

8355—October 15—Directing the C.P.R. to construct a suitable highway crossing over its right-of-way where the same passes across certain road allowance marked "proposed street," on the Lots 23, 24 and 25, First Con. Ottawa Front, Tp. Nepean, County Carleton, Ont.

8356—October 15—Authorizing the United Fuel Supply Company, Ltd., to lay gas pipe under the track of the C.P.R. on Lot. No. 7, 3 Con., Tp. Raleigh, Ont.

8357—October 9—Directing that the C.P.R. maintain highway crossing over the tracks of the C.P.R. at East Street, village of Ignace, Ont.

8358—October 11—Directing that the C.N.R. carry out provisions of paragraph one of Order of the Board dated the 16th October, 1905, with respect to the diversion of Thibault Street, St. Boniface, Man.

8359—October 11—Ordering that the C.N.R. commence to construct subway at Pembina Street, Winnipeg, Man., on or before the first day of November, 1909.

8360—October 11—Dismissing application of the City of St. Boniface, Man., to carry Provencher Avenue across the tracks of the C.P.R. in said city.

8361—October 11—Authorizing the C.N.R. to open for traffic its line of railway from Benito, mile 18.8 to Pelly, mile 35.6, on its Thunder Hill Branch, Man.

8362—October 11—Dismissing complaint of F. C. Berry, of Austin, Man., against the G.T.P for alleged improper fencing of its railway.

8363—October 11—Dismissing application of the merchants, farmers, and residents of the district of Purves, Man., for Order directing the C.P.R. to erect a station and appoint an agent at Purves, Man.

8364—October 11—Dismissing complaint of Laing Brothers of Winnipeg, Man., that the C.N.R. charge excessive interswitching rate with C.P.R.

8365—October 19—Granting leave to the G.T.R. to connect its railway track west of Fielden Street, Port Colborne, Ont., with railway track or siding being constructed by the Department of Railways and Canals, to reach Government Elevator No. 2, Port Colborne, Ont.

8366—October 18—Authorizing the town of Yellow Grass, Sask., to lay water pipe under the tracks of the C.P.R. at Yellow Grass, Sask.

8367—October 18—Authorizing Messrs. St. Clair Bros., of Gault, Ont., to lay and thereafter maintain gas pipe under the track of the G.T.R. where the same crosses Beverley Street and Stone Road, Galt, Ont.

8368 to 8372—October 8—Authorizing the Volcanic Oil & Gas Company, Ltd., to lay and thereafter maintain pipe line under the tracks of the Michigan Central Railroad at four points in the Tp. of Essex and one point in the Tp. of Maidstone, Ont.

8373—October 19—Authorizing the United Fuel Company, Ltd., to lay and thereafter maintain pipe for conveyance of natural gas, under the tracks of the P.M.R.R. between Lots 15 and 16, first and second Cons. Tp. of Chatham, Ont.

8374—October 13—Extending time within which the G.T.R. Company may appeal to the Supreme Court of Canada for leave to appeal from Order of the Board No. 7613, July 22nd, 1909; said Order directing the G.T.R. to provide station accommodation at or near the point where the railway company's line from Hamilton, Ont., to the town of Niagara Falls cross the town line between Tps. of Clinton and Louth, County Lincoln and Province Ontario.

(Continued on Page 498.)

## SELECTIVE ECONOMY IN RAW MATERIALS.*

**By Harry S. Mork, Engineering Chemist, Arthur D. Little Laboratory, Boston, Mass.**

The keen, aggressive competition of modern business demands the most careful scrutiny of every element of manufacturing cost. In spite of this, observations extending over a number of years, under peculiarly favorable conditions, have sharply emphasized the fact that the economic selection of raw materials is not given the painstaking, systematic consideration which this vital detail of every industry deserves. It is no exaggeration to state that there is probably not one manufacturing concern in operation to-day for which a substantial saving cannot be made in the cost of at least one, if not several, of its raw materials, without the slightest detriment to the quality of its finished products.

Where a true selective economy is exercised in the purchase of raw materials, the choice is not determined by either quality or price, but by the relative industrial efficiency of the materials under consideration. The opportunity to economize may, therefore, lie in the substitution of a high-priced material for a cheap one; in a change from a coal which the fireman likes to one which gives more heat for a dollar; in selecting lubricants with reference to their physical constants instead of by brand; or, very commonly, in discarding altogether some particular material long in use in favor of another more efficient at the price.

Large industrial corporations provide and maintain purchasing departments, the duties of some of which apparently end when the necessary materials have been purchased from the customary source of supply, or at the best offered prices. To meet its full responsibility, and rise to its proper place in the organization which it serves, the purchasing department must have a much broader aim, and must search for and investigate every possible chance for economy which may have its origin in the source, properties and group relationships of available raw materials, no less than in their price. That so many purchasing departments voluntarily limit their scope and fail to grasp their opportunities, is explained by several reasons, of which the more important are:

First, lack of knowledge on the part of the purchasing agent of the fundamental chemical or physical qualities which make the material suitable. To be sure the majority of purchasing agents are not technically trained men, and cannot be expected to know many of these qualities. Consequently they cannot adequately appreciate what the market affords in materials with the suitable fundamental properties, especially when these are not obviously characteristic.

Second, ignorance of the group relationships of particular raw materials with other materials, which are thus overlooked, though equally available.

Third, lack of knowledge as to the source or origin of the specific materials offered. It is easy to pay too much for wood pulp under the name of filter masse, or for waste soda pulp liquor when buying boiler compound, or for type foundry waste when it appears as a special bearing metal.

Fourth, the tendency to adhere to the raw material, standarized years previously, because it has been demonstrated by long experience that it will do the work satisfactorily. While such an attitude does have its points of justification, far too often the case is one where great economies can be effected, but where the opportunity is unrecognized or lost.

Finally, and most important as the common underlying cause of all the others, the unwillingness to learn so often shown by those who should be broadest, but who are stubbornly and persistently narrow and intolerant of the views of others whose school may not be of such long experience, but rather of more varied training and more advanced thought.

Organized and co-operative effort is essential to the success of every large industrial concern. Without it there must be unnecessary losses. It certainly cannot be neglected in the selection of raw materials. For best economy there must be co-operation between the purchasing department and every consuming department, and especially should there be co-operation with the industrial chemist and chemical engineer, whose business it is to keep abreast of the rapidly-changing modern conditions of production, and who is in position to follow the course of a material from its first manipulation to its ultimate use, through many different processes and varied applications.

True it is that a material that is strictly raw when it is used unaltered in a manufacturing operation, but "raw material" may be defined broadly, and is here considered as any material the regular or periodic consumption of which is essential to the manufacture of a finished product. In the majority of instances the raw materials of one industry are the finished products of another, as, for example, wood pulp, bleach, alkali, flour, oils, glue, and paper.

In accepting the above conception of raw materials it becomes apparent that these may be derived from various sources. They may be obtained from natural resources or they may be the result of a manufacturing process, of which they may either be the primary product, a by-product or a waste. This last source is not by any means of slight consideration, and the history of the last few years has shown that live men are now awake to the great possibilities of large profits to be derived by successful utilization of wastes as raw materials in their own or other industries.

Raw materials may be classified in a number of groups, the factors to be considered in economical selection differing for these various groups. Such a classification may be made as follows:

* Presented at Annual Meeting of the American Chemical Society, New Haven, Conn.

First, materials which are simply refined.

Second, materials which become a component part of the finished product, undergoing varying degrees of alteration.

Third, where no part of the raw material appears in the finished product.

As simple examples of the class where the material is refined, we have raw sugar which goes through the various processes of solution, filtration, decolorization, crystallization, and granulation, in its conversion into granulated sugar; crude camphor, which has to be resublimed before it can be used in celluloid manufacture or as a drug; bauxite, or native alumina, which must be freed from iron and otherwise purified before it can be used in the electric furnace manufacture of aluminum, or in the production of the high-grade paper-maker's alum; crude argols from which is prepared cream of tartar.

In selecting materials of this class which shall be the most economical, much more than the mere price must be considered. The instances in which the lowest-priced material is actually the best are few in comparison with the many cases in which a higher-priced material is really the cheapest to purchase, because of its greater industrial efficiency. Moreover, if the goods are bought at the source of supply, differences in freight rates and losses in transportation influence decidedly the cost at the mill. The American cotton bale is so poorly put together that very few bales reach their destination intact, and the losses of cotton are sometimes so considerable that the evil is a subject of constant agitation. Cases are known where sections of railroads have practically been ballasted by the iron ore which has dropped from the cars. Liquids which are transported long distances in barrels or casks rarely net the same at their destination that they do at the point of shipment, and allowance must be made for leakage, the burden invariably falling on the consignee.

When the proper allowances have been made, and the cost of the material delivered at the refining plant is determined, the next factor to be considered is the percentage of refined product the raw material may be expected to yield. A chemical analysis will tell a great deal as to possible maximum yield: in other words, it will tell exactly how much of the desired ingredient is present, and will very probably tell how this is associated or combined with the other constituents. For these reasons an analysis is exceedingly important. It is, however, only a relative indicator of cost, as the nature of the impurities may be such that their removal can be effected only at a great expense, or be accomplished only by a considerable sacrifice of that portion of the raw material it is desired to preserve. Frequently it occurs that the valuable component of the raw material is so combined that its separation necessitates much more expensive processes than the separation of the same component from a material in which it is differently combined. In such cases, economy is determined not only by percentage composition, but by cost of separation. The mineral industry furnishes many examples of this nature. Many ores containing valuable metals in considerable amount are far more expensive to work than other ores of much lower assay. An iron ore analyzing high in iron, but also relatively high in phosporus, is more expensive to work than a lower grade ore with low phosphorus content.

The second class includes such materials as textile fibres, pigments, waxes, varnish, gums, wood pulp, oils and dyes; or, more specifically, raw cotton fibres are spun into yarns and woven into fabrics without the chemical composition of the original fibre being altered. Shellac is dissolved in alcohol to make a varnish, but it still remains shellac.

This class includes also materials which in becoming part of the finished product are chemically altered, like napthalene in the production of synthetic indigo; sulphur, or pyrites, in the manufacture of sulphuric acid; ores; cotton in the manufacture of soluble cotton; oils and alkali for the manufacture of soaps; and so on. When napthalene is converted into artificial indigo, it is first changed into phthalic acid, an entirely different chemical compound. When sulphur is converted into sulphuric acid, the first operation is to burn or oxidize the yellow sulphur with which every one is familiar into the colorless, stifling gas, sulphurous acid. In these two examples, the original substance is not only changed chemically, but also altered physically in a very marked manner. When, however, ordinary absorbent cotton is changed into highly explosive gun cotton, the cotton is converted into a different chemical compound, cellulose nitrate, but practically retains all the appearance of the original cotton.

As in the case of materials to be refined, location of the source of supply, freight, and transportation losses are important. It is also absolutely necessary that sufficient supply be available. It is no use to select one of several materials because it is the lowest priced, even if the other economy factors are equal, when the supply of the cheaper material may at any moment be cut off, especially when the margin of profit of the finished product is small, and the finished product is sold under a rigid contract.

The yield of finished product is obviously of prime importance. Directly associated with this is the quality and character of the waste. The value of a waste is in many instances just as vital a factor in determining the volume of profits as is the purchase price of the raw material itself. The price which can economically be paid for pyrites in the manufacture of sulphuric acid is often determined quite as much by the proportion of copper in the slag as by that of sulphur in the original material. Textile fibres offer an excellent example, for the short waste fibres from the pickers, and the card, and the combs, are a direct source of income to the mills. The conversion of blast furnace slag into cement affords another fine illustration, and the utilization of blast furnace gas for heat and power is now a very ordinary occurrence. The extraordinary statement has been made that in the not very distant future the blast furnace will be operated for the gas it produces, and that pig iron will be a by-product.

The opportunities for utilization of wastes are still many, and the conversion of a waste into a commodity means increased prosperity to the community. If all the flax waste straw lying valueless in the West were converted into half-stuff or pulp for paper, it would mean a great deal to the farmer and much to the paper-maker. If it were possible to utilize all the waste cellulose which grows each year and which is either burned or rots away, as the cotton stalks of the South, or the cane brakes of Louisiana, the problem of the preservation of our forests would be much simplified. Of lesser scope, but deserving of equal consideration, is a waste which is the direct result of some mechanical operation or of some chemcal process. To use such wastes adds to profits; not to use them may mean direct financial loss, for should the waste become a nuisance the way is paved for litigation and damage costs, or for the expense of relocation.

It may be of interest to indicate how a number of manufacturing wastes have been turned to profit. Sawdust can now be burned with facility under a boiler; its fuel value is about 40 per cent. of the average coal. Treated with alkali, it

produces oxalic acid; and when pulverized it becomes useful as a substitute for ground cork in linoleum manufacture, or an absorbent for nitroglycerine in the production of dynamite. Tin plate scrap has for a number of years been a marketable product; the tin is removed from the sheet iron either chemically or electro-chemically, and both tin and iron find a ready market. The waste liquors from iron and copper pickling vats are now used as precipitants in the purification of potable waters. The waste wort from the modern malted breakfast food factories is fermented to vinegar. Gluten is made from starch factory wastes, lemon oil from the peel of culled lemons, wrapping paper from sulphite pulp screenings, and so on.

In selecting a raw material it is equally necessary to estimate how large an item of expense will be the labor and the power required to convert it into the market product. It not infrequently happens that the labor and power costs are in excess of the cost of the raw material. Consequently it is not economy to select the cheapest stuff to be found if it takes a disproportionate amount of labor to use it. In selecting a paint as a protective coating for either iron or wood, the cheapest paint will probably prove the most expensive when measured by the number of coats necessary to apply and frequency of renewal. There are, of course, cases where cheaper materials do sometimes require less labor in their conversion into the finished product. Lead in copper bronzes reduces the cost, and also makes them much more easily machined. A trolley wheel containing several per cent. of lead is much more easily turned than one without lead. As to the mileage such wheels will give is quite another question, and it is probably now generally conceded that high lead means short life.

The third class, in which no part of the raw material appears in the finished product, embraces substances of very diverse character and functions. It includes all materials which are catalytic in their action, like platinum. A catalyzer is a substance which by its mere presence increases the rate and efficiency of a chemical process without itself suffering any change. Closely allied are those materials which assist in the formation of the product, and are subsequently recovered, such as sulphuric acid in the manufacture of artificial essences and flavors. Here, the acid acts as a dehydrating agent, absorbing the water which is formed by the process, and ultimately becoming diluted to a point where it is no longer efficient. Quite different, but in the same broad class, are certain solvents such as acetone, alcohol, ether, etc., used in producing photographic films; or extraction solvents, such as naphtha in recovery of wool grease. In the first group the solvents, which are subsequently recovered, are used to alter the physical form of some other material; in the second group the solvent merely traverses the material and removes therefrom, without otherwise altering it, all substances soluble in the solvent. Some materials react on the basic raw material, and are themselves altered but subsequently recovered. This is illustrated very well by the ammonia used in the manufacture of carbonate of soda, by the ammonia soda process, and by the soda liquors of the soda pulp manufacture. They are also materials which produce an effect but are themselves destroyed, such as bleaching powder or the sawdust which is mixed with clay in forming porous terra cotta, and afterward burned away in the baking.

The most important materials in this class are those which never come in contact with the finished product during any stage of its manufacture, but which are absolutely essential to its production. Examples of such raw materials are found in lubricating oils and coal. This classification refers to coal used for power; gas coal and coal for coke fall more properly in the class where the material becomes part of the finished product with chemical alteration.

Coal is so universal a raw material, and coal economy so important and such a specialized subject, that an extract from a recent publication of this laboratory is well worth quoting. It says: "In buying steam coal the amount of heat that may be developed from it is the measure of its value to you. There is no by-product that may be utilized, except that in some cases the sale of ashes might be considered in this connection, but their removal is generally an additional expense. Two coals at the same price and containing the same number of heat units may not be equally desirable. The difference in volatile matter might cause the lower to prove more satisfactory under certain conditions of smoke restriction, while the higher volatile coal would probably be more applicable in a plant with fluctuating load. The amount and nature of ash in regard to the formation of clinker often needs to be considered.

"The liability of spontaneous combustion of one coal more than another, may make it advisable to pay several cents per ton more for one coal containing no more heat units than the other."

Referring to seven different coals, the analyses and results of evaporative tests of which are tabulated, this publication shows that of the seven neither the intrinsically best nor the lowest-priced coal would be the cheapest to buy.

As for lubricating oils, opportunities for economy can be found in most factories. In one of the largest corporations in the country, an expensive cylinder oil was being used on its machinery where a heavy machine oil would have answered equally well, with a saving of over $2,000 per year. There are many instances where equally efficient but cheaper oils can be substituted for more expensive ones; this is particularly true of cutting oils. But probably the greatest source of saving will be in the knowledge that one mill will be using the identical oils that the mill next door is using, but is only paying two-thirds the price for them.

Of the other materials of this class, which are no part of the finished product, economic selection is determined by the original cost, the relative power to do the work, the ease of recovery, the amount recoverable, and the effect on the apparatus and workmen. Carbon tetra-chloride is a solvent which is much more expensive than naphtha; it has anaesthetic properties similar to chloroform, consequently the workmen must be protected from its vapors; it also has slight corrosive action on iron containers; but it has the immense advantage of being non-inflammable, while naphtha is exceedingly combustible and forms highly explosive mixtures with air. The property of non-inflammability reduces the fire risk and effects a saving in insurance. Insurance, although compensating for actual property destroyed, rarely makes allowance for loss of business during reconstruction.

Looking at raw materials broadly and without classification, there are a number of points of special interest. As stated before, the cases in which the lowest-priced material is actually the cheapest are few in comparison with the number in which the higher-priced material is really most economical. Of the former, mention can be made of synthetic indigo, which is not only cheaper than natural indigo, but is also better. If the hopes of the indigo planters are realized, improved methods may enable them to reverse this condition. Sulphate of alumina is cheaper than crystal alum, and when valued on its alumina content is much more efficient; retort carbon at five cents is better as an electrode

for aluminum manufacture than graphite at fifteen to seventeen cents; ultramarine is cheaper and better than smalts. In the latter case, in which higher-priced materials are most economical, mention can be made of carborundum, which costs more than emery, but has far greater efficiency. A cheap babbitt metal is more expensive than a higher-priced one, if its intrinsic value is commensurate with its price. Steel trolley wheels have a cheaper first cost than bronze wheels and give a longer mileage, but serious wear on the trolley wire, and the high loss of power through resistance, probably more than compensates for the difference in first cost. Copper generally, but not always, has a higher industrial efficiency as an electrical conductor than iron. Under some conditions of price and service aluminum should be preferred to either. Carloads of sal soda have been used because it costs less than soda ash, and because of ignorance of the fact that it is only three-eighths as strong. The balance is just water, what is known as water of crystallization, which in itself never makes crystals appear moist or wet, and which, therefore, is not obviously present.

This example introduces another element of consideration. Every manufacturer realizes that water costs something, but it does not cost as much as soda ash, or as much as paint, or as much as the sizing dissolved in it. Dry materials are better because they are really cheaper, because the freight bill will not be so large, because they are more uniform, and because you know what you are actually paying for. If it is necessary that water be present, the purchaser can himself add it to better advantage.

There are many instances where cheaper materials have been substituted for more expensive ones without decrease of efficiency, and the field for economic substitution is still very large. Casein has taken the place of glue in paper coating, celluloid the place of hard rubber, and kerosene the place of whale oil. In the other hand, the composition or quality of the finished product frequently determines the selection of a raw material. For a very white, high-grade paper a hydrate alum, practically free from iron, must be used; for a lower grade paper a bauxite alum will answer to every extent as well. Ground wood papers have their field in ephemeral publications, but have no place where permanency is essential. Caustic soda will make good, hard soap, but the more expensive potash is required for soft soap.

It is to be regretted that it should ever happen that opportunities for economy are lost, because some one in the organization sacrifices his integrity and loyalty to personal gain. The textile chemical dealers probably have to meet this unfortunate condition more frequently than almost any others, but they are by no means alone. It is difficult to say, where such conditions exist, who is the more to blame, the salesman who, to push his goods, makes presents or allows secret commissions to the purchaser's employees, or the dyer or engineer or pressman who allows himself to be so easily corrupted. All are doing just so much to undermine the industrial efficiency upon which the welfare of the whole community depends.

The highest possible industrial efficiency, measured finally, as it must be, in terms of dollars and cents, although involving many other factors and leading to greater and better ends, is in the last analysis the test and object of selective economy in raw materials. It is the duty, as it is becoming in large measure the privilege, of the industrial and engineering chemist to raise the standard and increase the output of productive effort, and in no way does he do this more effectively than by enabling the manufacturer or the purchasing agent of a public service corporation to properly evaluate and control the quality of his supplies, helping him in the selection of the most efficient, and, therefore, the most profitable of available materials, and insuring to him by chemical control that the selected material is, in fact, delivered and held to quality in every shipment.

## RAIL GROOVES AND TRACK GAGE FOR CURVED TRACKS.*

By C. W. L. Filkins, M.C.E.

The primary principle of wheel contact on curves is that the forward inside wheel of a car truck shall bear against the inside guard and the rear outside wheel against the outside guard, thus keeping the flanges of all of the wheels clear of either rail head and eliminating the side-wear on the heads. In practice this is impossible, due to irregularities, and could not be maintained, due to the wearing of the guards. The ideal conditions would be new wheel flanges and a particular rail for every curve, wheel-base and flange,

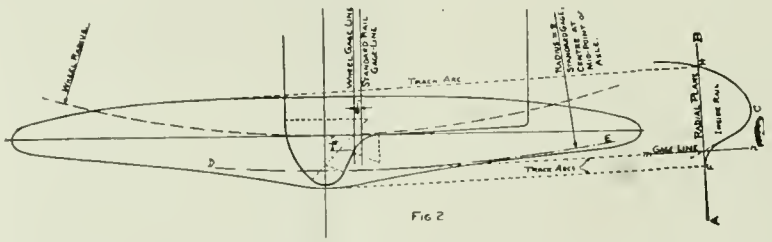


Fig 2

but this is prohibitive, both for the traction company and the manufacturer, owing to inaccuracies in wheel setting, different flanges and wheel-bases over the same track, and most particularly to the necessarily limited number of types of rolled guard rail sections.

### Determination of Minimum Groove.

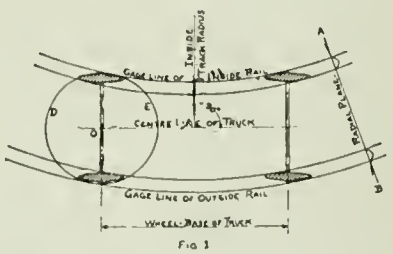
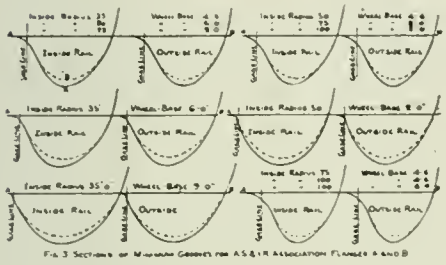


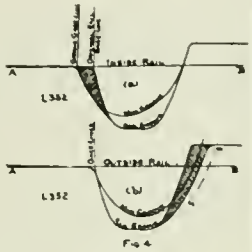
Fig 3

Having a fixed rail groove as above intimated, it is desired to know if that groove will properly serve under the given conditions, and if not, how to alter it to meet them. Without discussing the question of wear on wheels or rails, as others have somewhat thoroughly considered that in the forms of wheel flange and rail groove, let us find the mini-

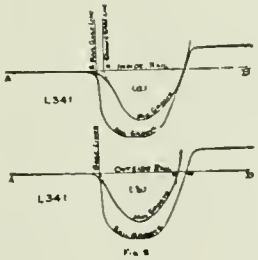
*Paper presented as a part of the report of the Committee on Way Matters.

mum groove in which a given wheel flange will run, on the assumption that the equipment is geometrically perfect. In a car traversing a curve, the longitudinal axis of the car truck is normal to the radius of curvature of the track drawn to the mid-point of the truck, the wheels being held rigidly parallel to the axis. The portions of the wheel flanges which determine the size and shape of the minimum groove are the portions below the shaded sections shown in Fig. 1. The shaded areas are sections of the wheels on a level with the wheel-tread. If we project these portions of the flanges upon a radial plane, we obtain the contours of the minimum grooves, as shown at AB. To obtain these projections (see ABC, Fig. 2), pass a series of planes perpendicular to the axis of the truck. They will cut lines from the surface of the flange. Project these lines by means of track arcs upon the radial plane AB (shown rotated about line AB, as an axis, into the plane of the paper). The outline curve FCH, tangent to all of these projections, is the contour of the required minimum groove.





The gage-line of a grooved rail or of a groove is customarily taken as the intersection of a horizontal plane through the tread-line with the head side of the groove produced, the rounded corner being ignored. Accepting this in what follows, we inquire the position of such a gage-line for the minimum groove as compared with a gage-line as determined by the standard gage. If in Fig. 1 with the mid-point O of the axle as centre, we describe the circle D-E, of diameter equal to standard gage and draw track arcs tangent to D-E,



**Rail Grooves and Track Gage for Curved Track.—Figs. 1, 2, 3, 4, and 5.**

one on each side, and produce then to A-B (Fig. 2), we determine the position of the standard gage-line. Only one such determination—at m-n—is shown in Fig. 2. For wheels set to a gage ¼-in. less than standard gage and with the wheel gage-line taken at a point on the fillet of the flange ¼-in. below the level of the tread, it is found that the standard gage-line and the minimum groove gage-line coincide for all flanges used at the present time. This also holds for M. C. B. flanges set to M. C. B. Association standard (M. C. B. Association Report of 1907). There may be a slight exception to the above conclusion in the case of American Street and Interurban Railway Engineering Association flanges A and B, for which the groove gage-line appears to fall outside the standard gage-line 1/32 in. for large wheel-bases and very short track radii. As other conditions will cover this item, we will ignore it in what follows.

By the method set forth above, the following set of minimum grooves has been obtained for the American Street & Interurban Railway Engineering Association flanges known as A & B (See Fig. 3.)

The dotted lines refer to flange B, the gage-line shown on these contours indicates the position of the standard gage-line, as explained above. In a similar manner, the minimum grooves for other flanges have been plotted, and the data so obtained used in Fig. 6, as will be explained later.

In what follows we premise that, owing to the uniformity of the wheel flange section, the practical inside groove required under given conditions is the same as the minimum groove for the same conditions; also that the inside guard guides the truck around the curve.

For equipment at the present time seems reasonable to limit the range of irregularities in wheel setting to ¼ or ⅜ in. to each wheel, distributed 1/16 in. on each side of the normal position of the wheel. Since this variation may occur simultaneously to double the effect, there is an ⅜-in. change outward and inward from the normal position of the outside wheel flange. The outward movement will seldom require attention, as it will probably be taken up by the fillet and riding on the head of the outside rail, and practice indicates that irregularities in that direction are rare. The inward movement of ⅜ in. must be provided for by holding the outside guard back, thus increasing the width of the outside minimum groove that amount for practical purposes.

Let us now adapt the minimum grooves of Fig. 3 to the following case: American Street and Interurban Railway Engineering Association flange A, Lorain Steel Company rail section No. 341, inside track radius of 50 ft., and wheel-base 4 ft. 6 in. Place the guard of L-341 tangent to the inside minimum groove contour for the given conditions—see Fig. 5 (a). The minimum groove lies wholly within the rail groove, and the rail gage-line fails to coincide with the standard gage-line by the amount M-N. Evidently the standard gage should be widened the amount M-N, and there is no planing of the rail section for the inside rail. Fit the head of the rail section into the outside minimum groove contour—Fig. 5 (b). The rail and standard gage-line coincide, and hence there is no widening of the gage due to this last operation. If V-W be not less than ⅜ in., the outside groove will be sufficiently wide to take care of irregularities. In general, if the width of the given rail groove exceeds that of the inside minimum groove, widen the standard gage the amount of the excess, the wheels being set as explained above. A further widening of the gage will but decrease V-W, and ultimately the wheels will bind between the guards, unless the outside groove were planed to greater width.

By width of groove is meant the horizontal distance between the guard and the gage side of the groove measured on a level with the tread, the rounded corner due to fillet or head being ignored. By plotting the widths of the minimum grooves as abscissae and the wheel-bases as co-ordinates, it is found that for a given flange the width of the groove varies directly as the wheel-base and inversely as a function of the track radius. Without insisting upon an accuracy closer than 1/32 in., the following simple formula for the width W (in inches) of the minimum grooves for the American Street and Interurban Railway Engineering Association flanges A and B was obtained:

$$W = \frac{1}{16}\left(\frac{45\,B}{R} + 18\right)$$

where B = length of wheel-base in feet and R = radius of the curved rail in feet. Similarly for M. C. B. flange:

$$W = \frac{1}{16}\left(\frac{8{,}000\ (B-2)}{R^2 + 100\ R} + 24\right)^{\frac{1}{3}}$$

Six other flanges, whose groove widths have been used in Fig. 6, were determined in a similar manner, the formulae being similar in form to the first one given above. The formula for the American Street and Interurban Railway Engineering Association flanges does not give grooves wide enough by 1/16 in. or less for radii much in excess of 100 ft., but above 100 ft. the minimum groove differs inappreciably from the form and size of the flange section.

By means of the grooves which have been plotted, we are enabled to note the effects of variations in the given data as follows:—

(a) The width of the groove increases directly with and in the same amount as the width of the wheel flange.

(b) Increasing the depth of the wheel flange slowly increases the width of the groove, depending greatly upon the form of the flange in obtaining the increased depth.

(c) The effect of wheel radius upon the grooves is negligible for the present range of wheel radii.

(d) The effect upon the grooves of different track gages from 4 ft. 8½ in. to 5 ft. 4½ in. is inappreciable.

(e) The factors, outside of the wheel flange, which critically affect the grooves, are the length of the wheel-base and the track radius.

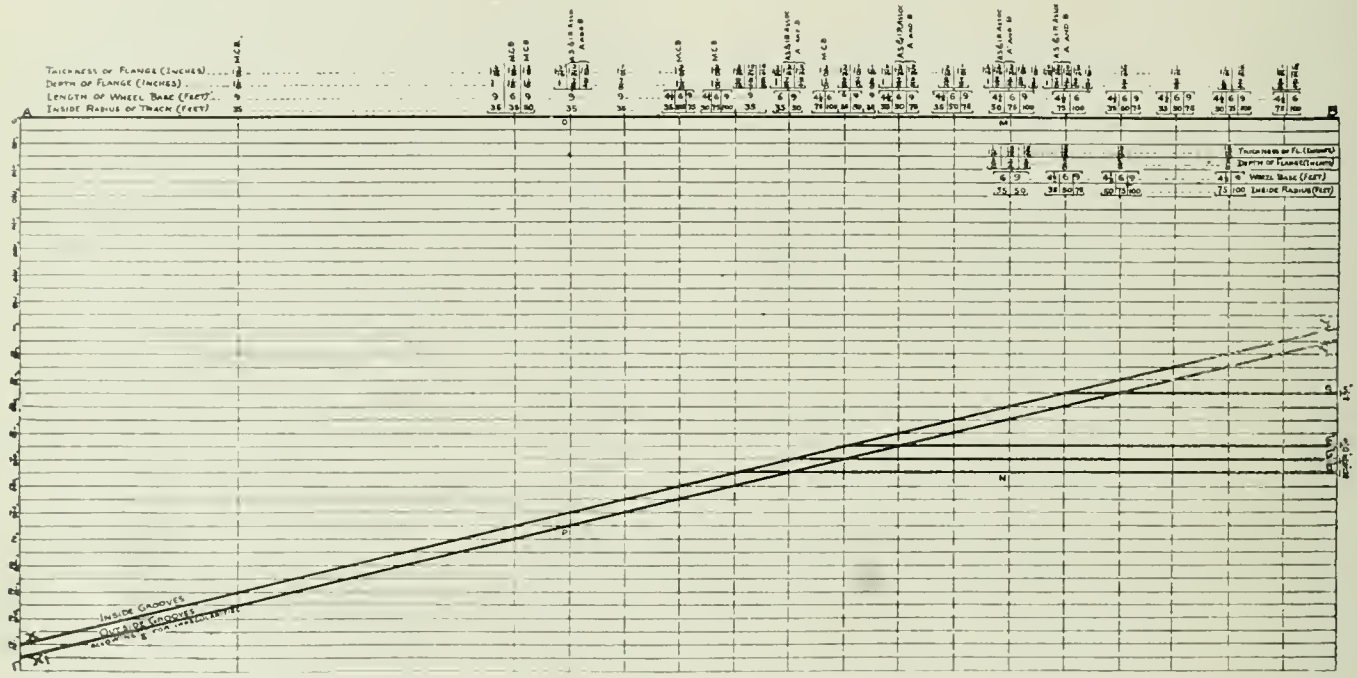
(f) For track radii greater than 100 ft., the minimum groove is practically the same as the flange section.

(g) The effect of the gage is to make the width of the outside minimum grooves about 1/16 in. less than for the inside; hence the practical outside groove, allowing ⅜ in. for play, should be 1/16 in. greater in width than the inside minimum groove.

Using the inside minimum grooves as a basis (Fig. 6), draw a convenient oblique line X-Y as referred to a fixed base-line A-B. By means of the vertical scale, find points on X-Y at distances below A-B equal to the widths of these inside minimum grooves and draw the verticals to A-B, designating them as there shown. Results for a 7.5 ft. wheel-base have not been tabulated, but values for this wheel-base may be read off from Fig. 6 by direct interpolation. Thus, for a flange 1⅛ in. thick, ⅞ in. deep, and a 50-ft. inside track radius, the width of groove is 1 9/16 in. for a 9-ft. wheel-base and 1 7/16 in. for a 6-ft. wheel-base; hence 1½ in. is the width of groove for a 7.5 ft. wheel-base, as would be given by the mean vertical.

Since the width of the practical outside groove must be 1/16 in. wider than that of the inside minimum groove, in Fig. 6 draw $X_1$-$Y_1$ 1/16 in. below X-Y. The vertical lines between X-Y and A-B give the necessary widths of inside grooves for the given conditions, as indicated at A-B, and similarly the necessary widths of the outside grooves, ⅜ in. being allowed for irregularities, are given between $X_1$-$Y_1$ and A-B.

Theoretically the rail grooves should have the widths thus obtained, but we are limited by the commercial product in rolled sections, the widths of grooves of which are 1 5/16 in., 1 9/16 in., 1⅝ in., and 1 11/16 in, and a few specials.




The vertical distances between base-line AB and line XY represent the width of inside groove, measured on the level of the tread line of the rail, to pass the wheel flanges, in combination with the wheel-bases, on curves of the radii, all as given at the base-line AB. The vertical distance between line AB and line $X_1$ $Y_1$ represents the width of the groove of the outside rail which should be used in conjunction with that given for the inside rail, to allow for variations in wheel setting.

For wheels set to a gage ⅛ in. less than the standard track gage and with the wheel gage-line taken at a point on the fillet of the flange ¼ in. below the level of the tread line, curves with grooves as in diagram shou'd be laid to standard track gage.

Horizontal lines G, G′, G″, and G‴ represent the width of grooves in commercial girder guard rails now rolled. Where the width of groove necessary for the combination of wheel flanges, wheel-bases and radii, as given by the diagram, is smaller than the width of groove in the girder guard rail to be used, the gage of the track on the curve should be widened by an amount equal to the vertical intercept between the line XY and the lines G, G′, G″, and G‴ respectively. Where the width of the required grooves are greater than the width of the rail groove, the amount of p'aning is indicated by the intercept between XY and $X_1$ $Y_1$ and the lines G, G′, G″, and G‴ respectively.

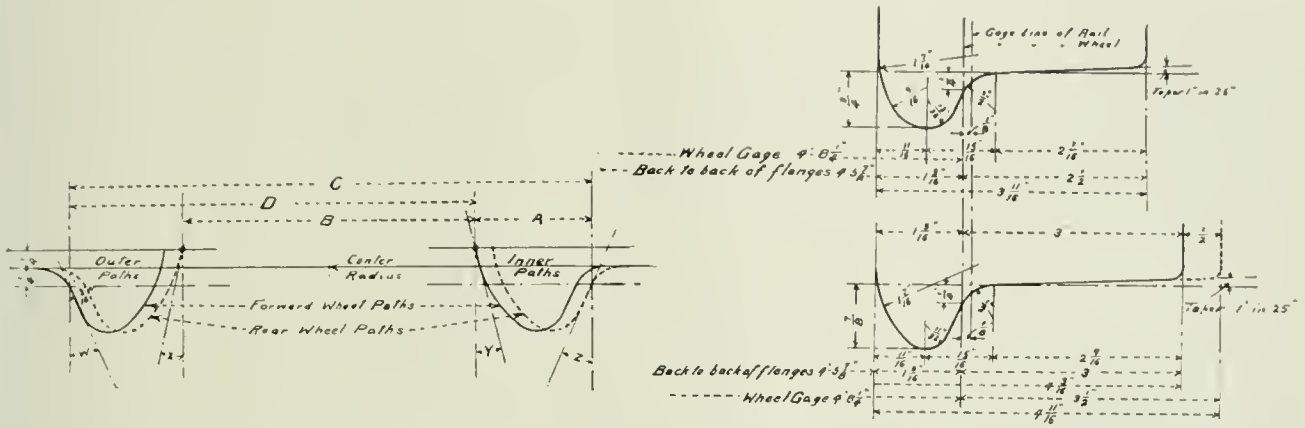
**Rail Grooves and Track Gage for Curved Track—Fig. 6—Width of Rail Grooves on Curves Under Varying Conditions.**

The widths of these grooves are shown in Fig. 6 by the horizontal lines G, G′, G″, and G‴. The effect of using some standard rail under given conditions, is now easily seen. For example, for American Street and Interurban Railway Engineering Association flange A, wheel-base 9 ft., inside radius 100 ft. and a 1 9/16-in. grooved rail; on line M-N on Fig. 6, we read the required width of inside groove = 1⅜ in. and of the outside groove = 1 7/16 in. Evidently the 1 9/16-in. groove of the given rail is 3/16 in. wider than the required inside groove and ⅛ in. wider than the required outside groove, as easily seen by the intercepts on M-N between G′ and X-Y or $X_1$-$Y_1$ respectively. Hence the gage must be widened 3 16 in., the intercept on M-N between X-Y and G′. We also note that there is a clearance of ⅛ in., the intercept on M-N between $X_1$-$Y_1$ and G′, between the outside flange and the outside guard over and above the allowance for irregularities. It might be well in this case to widen the gage an additional ⅛ in. and thus make greater allowance for irregularities and obtain earlier bearing against the inside guard.

1⅞ in. wide. The intercept on O-P between X-Y and a horizontal line corresponding to a 1⅞-in. groove is zero; hence there will be no widening of gage.

For the determination of the exact amount and contour of planing, place the guard of L-352 tangent to the inside minimum groove contour for the given conditions. See Fig. 4 (a). The shaded portion shows the amount of planing necessary to adapt this rail to the conditions. On planing this rail evidently its new gage-line will coincide with the standard and the minimum groove gage-lines, since the latter practically coincide, thus again showing that there will be no change in the standard gage due to this operation.

Now fit the head of the rail section into the lines of the outside minimum groove for the given conditions. It is seen that the rail gage-line and the standard gage-line coincide; hence there will be no widening of the gage for these particular conditions, provided we do not allow for any irregularity in the setting of the wheels which would tend to increase the normal gage distance. That such irregularity




| Cen Rad of Curve | 4'6" Wheel Base | | | | | | | | 6'0" Wheel Base | | | | | | | | 7'6" Wheel Base | | | | | | | | 9'0" Wheel Base | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | W | X | Y | Z | A | B | C | D | W | X | Y | Z | A | B | C | D | W | X | Y | Z | A | B | C | D | W | X | Y | Z |
| 35' 0" | 1 11/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 23°0 | 17°15 | 18°45 | 22°15 | 1 3/4 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°25 | 18°45 | 23°30 | 22°45 | 2 1/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 27°20 | 20°30 | 24°30 | 27°15 | 2 1/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 30°35 | 23°40 | 28°30 | 30°25 |
| 40' 0" | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°30 | 16°35 | 16°30 | 24°20 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 26°00 | 15°40 | 20°30 | 22°15 | 1 15/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°15 | 18°40 | 23°10 | 25°00 | 2 1/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 27°35 | 21°30 | 25°30 | 27°40 |
| 45' 0" | 1 11/16 | 4 3 5/16 | 4 8 1/2 | 4 6 3/4 | 24°40 | 15°00 | 15°30 | 24°05 | 1 11/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 26°05 | 13°50 | 18°30 | 22°10 | 1 15/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°20 | 16°45 | 21°05 | 25°15 | 1 15/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°25 | 19°30 | 24°35 | 26°00 |
| 50' 0" | 1 11/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°00 | 11°10 | 14°00 | 24°20 | 1 3/4 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 26°35 | 12°55 | 17°10 | 24°30 | 1 3/4 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°30 | 17°20 | 19°25 | 24°10 | 1 15/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°35 | 18°30 | 19°35 | 25°30 |
| 60' 0" | 1 11/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°45 | 9°25 | 13°20 | 25°00 | 1 11/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 26°25 | 11°40 | 13°50 | 22°15 | 1 15/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°40 | 15°00 | 17°15 | 25°00 | 1 15/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°35 | 17°40 | 18°30 | 25°05 |
| 75' 0" | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°35 | 8°25 | 11°25 | 25°00 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 26°25 | 9°35 | 10°05 | 24°10 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°00 | 11°45 | 15°05 | 24°25 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°15 | 15°40 | 15°35 | 24°15 |
| 100' 0" | 1 11/16 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 23°30 | 6°00 | 8°00 | 23°30 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 23°30 | 8°00 | 10°20 | 23°30 | 1 1/2 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 25°00 | 9°50 | 12°05 | 24°30 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4 6 3/4 | 24°30 | 12°25 | 13°55 | 24°10 |
| 150' 0" | | | | | | | | | | | | | | | | | 1 7/16 | 4 3 1/4 | 4 8 1/2 | 4' 7" | 25°00 | 7°15 | 8°00 | 25°25 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4' 7" | 25°25 | 8°50 | 10°00 | 24°20 |
| 200' 0" | | | | | | | | | | | | | | | | | 1 3/8 | 4 3 1/4 | 4 8 1/2 | 4' 7" | 25°30 | 5°50 | 7°00 | 25°30 | 1 5/8 | 4 3 1/4 | 4 8 1/2 | 4' 7" | 25°30 | 5°50 | 8°05 | 25°30 |
| 300' 0" | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wheel Path Development Drawing No 51522 | | | | | | | | | Wheel Path Development Drawing No 51512 | | | | | | | | Wheel Path Development Drawing No 51532 | | | | | | | | Wheel Path Development Drawing No 51542 | | | | | | | |

**Way Matters—Tabulated Flange Path Data, Prepared by Pennsylvania Steel Company**

With the same flange, wheel-base and same rail, let us try a 35-ft. radius. It is seen that the rail groove is 5/16 in. narrower than is required by the inside flange and ⅜ in. too narrow for the outside flange. The head of the inside rail must be planed 5/16 in. and the outside guard ⅜ in. The locations of these planings are so taken as to least affect the wearing portions of the rails, as shown in Fig. 4. Since planing a rail places it in a type with a wider groove, it must be placed in the wider groove class in examining for change from the standard track gage. The inside rail groove is now

Note.—The thickness of flange as used on this diagram (Fig. 6) is measured on a level with the wheel tread and is the distance from the guard side of the flange to the wheel gage-line, the latter being ⅜ in. inside of the standard track gage-line and at a point on the fillet ¼ in. below the wheel tread. The depth of flange is its extreme depth below the level of the wheel tread.

tends to decrease rather than increase the normal gage distance of the wheels is a practical fact.

From Fig. 4 (b) we see that planing of the guard is necessary, but due to irregularities in wheel setting, the total amount of planing is not immediately shown. Allowing for this ⅛ in. in Fig. 4 (b), as shown by the dotted line, and drawing the fine full line to give a reasonable groove contour, the shaded area shows the amount of planing of the outer rail for practical conditions. To reduce the amount of planing from either rail, a slight shifting of the section along A-B, requiring a slight planing of the guard in Fig. 4 (a) or of the head in 4 (b), may sometimes be advisable. By increasing the amount of planing of the outside guard by ⅛ in., and widening the gauge ⅛ in., allowance may be made for an outward movement of the outside flange for irregularities, and an earlier bearing against the inside guard also obtained.

For uniform practice it is suggested that in the case of

a widened gage the gage-line of the inside rail be made to conform to the geometrical position of the standard gage-line and the outside rail moved outward the amount the gage is to be widened. Geometrical purposes would thus require that the gage narrow abruptly at the points of tangency, even though not carried out in practice. Some of the usual methods of eliminating this widening in the neighborhood of tangents is to narrow the gage of the curve as it approaches the tangent; another is to carry the widened gage through onto the tangent and there gradually narrow down to the standard. As a matter of fact, the gage of the curved track contiguous to the tangent and the gage of the tangent should have an increased widening, as compared with the more central portion of the curve, as the straight track acts as a curve of increased radius in conjunction with the curve. This additional widening could be accomplished very effectively by giving a slight curve to an extension of the inside rail into the straight track, commonly called the straight guard on the end of curves.

### Conclusions.

In conclusion, we might summarize as follows: For the flanges in use at the present time and provided the wheels are set ¼ in. less than standard gage at a point ¼ in. below the level of the wheel tread; also allowing ⅛ in. for tightening of wheel gage due to irregularities in wheel setting.

(a) There will be no widening of the standard track gage when the width of the rail groove does not exceed that of the required inside grooves;

(b) If the width of the rail groove exceeds that of the required inside groove, widen the gage the amount of excess.

## VIRGINIA STATE HIGHWAY COMMISSION.

### Specifications for Bridge Masonry.

### Cement Rubble.

Rubble bridge and retaining wall masonry will consist of stones roughly squared, laid in irregular courses. The beds must be parallel, roughly dressed, and lie horizontally in the wall. Large flat stones shall be selected for the bottom. Each stone must be settled into place in full bed of mortar. The wall must be compactly laid, having at least one-fifth the surface of the back and face headers, so arranged as to interlock, having all spaces in the heart of the wall filled with suitable stones and spalls, thoroughly bedded in mortar. The face joints must not be more than 1 inch in thickness. The mortar shall be made of 1 part Portland cement, of a brand and quality approved by the State Highway Commissioner, and 2 parts clean, sharp sand, mixed in small quantities and at the time needed for immediate use.

If a stone becomes loose after the mortar has set, it must be relaid with fresh mortar.

The stones shall be hard and durable and at least six inches in the smallest dimension, and be free from seams or other imperfections, and in no case having a bed less than the rise.

The bridge seat and coping shall be built of selected smooth stones, well placed for the bearing plates.

For spans more than 150 feet in length the bridge seat and coping shall be made of concrete at least twelve inches in thickness.

### Concrete.

The concrete shall be composed of broken stone or screened gravel and sand (all of which shall be clean, hard, sharp and free from clay, dirt and other objectionable material), and Portland cement of brand approved by the Engineer, and fresh clean water.

For plain concrete, to each part of Portland cement there shall be by volume 3 parts of sand and 6 parts of broken stone or screened gravel, and such proportion of water as the Engineer may from time to time determine.

For reinforced concrete to each part of Portland cement there shall be by volume two parts of sand and four parts of broken stone, and such proportion of water as the Engineer may from time to time determine.

The broken stones or gravel stones shall not be greater than 2 inches in diameter, and where concrete is less than 8 inches thick not over 1 inch in diameter. Broken stone shall be free of dust.

The cement and sand shall first be thoroughly mixed dry, in the proportions specified, on proper boards. Clean water shall then be added and the materials thoroughly mixed. The broken stone, previously drenched with water, shall then be deposited in this mixture and the ingredients thoroughly mingled and turned over until each stone is covered with mortar. The concrete shall not be allowed to fall from any considerable height, but shall be carefully deposited without delay and thoroughly rammed in layers not more than six (6) inches in depth until the water flushes to the surface and all the voids are filled.

The concrete next to the centres or forms shall be spaded so that sufficient mortar will exude from the mass to form a smooth surface.

(Continued on Page 498.)

## PROBLEMS IN APPLIED STATICS.

T. R. London, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

**If the chain (Fig. 58) can safely stand tension to the extent of 1,500 pounds, what is the maximum weight that may be placed on the hook?**

Let the chain be stressed in tension to its limit of 1,500 pounds. Choosing a point where the line of action of the force due to the weight intersects the centre line of the chain, practically, the condition at this point is such as indicated by the statical diagram (Fig. 61), the chain exerting a tensile force of 1,500 pounds at each side of the point, and the weight, of as yet unknown magnitude, acting vertically downward. These three forces are in equilibrium; therefore, their vector polygon, if constructed, must close.

If BC and CA (Fig. 62) be drawn to represent accurately the two tensile forces exerted by the chain, it is evident that the line joining A to B must represent the force exerted by the weight, for if BC and CA have been properly constructed, AB closes the diagram and represents a vertical force acting downward.

If a perpendicular be drawn from C (Fig. 62) to AB, it may be geometrically shown that—

$$AB = \frac{1,500}{2} \times \sqrt{3} + \frac{1,500}{2} \times \sqrt{3} = 1,500\sqrt{3} \text{ pounds.}$$

The maximum weight, then, that may be placed on the hook is 1,500 √3 pounds.

Let Fig. 63 represent diagrammatically a small cantilever bracket, the load which it supports being equivalent to 1,000 pounds applied at the outside joint as indicated. **It is required to find the stress in the members of the truss.**

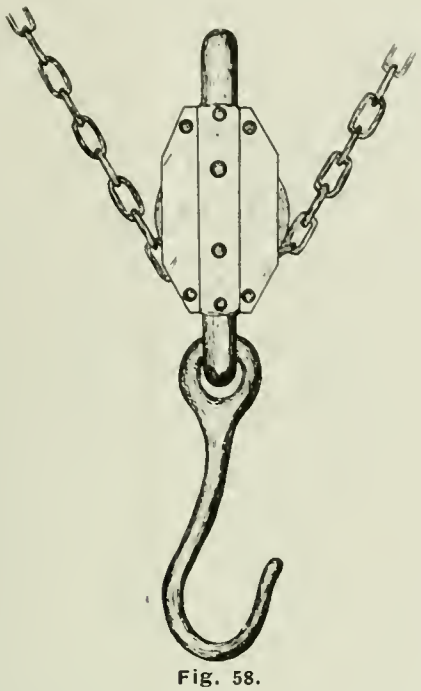


Fig. 58.

Consider the forces acting at the point ABC of the frame. There is a known force BC of 1,000 pounds acting vertically downward, and two unknown forces, CA and AB, whose lines of action are known. The Statical Diagram (Fig. 64) represents this condition of affairs.

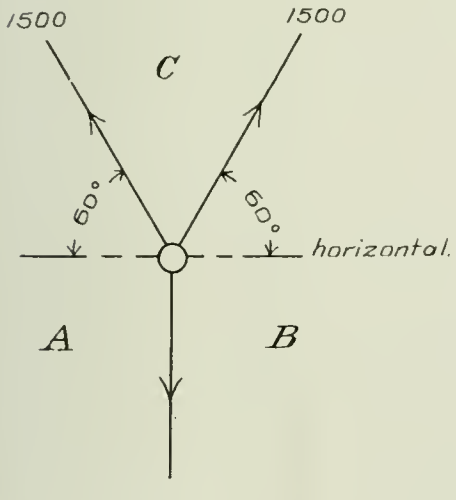



Fig. 61.

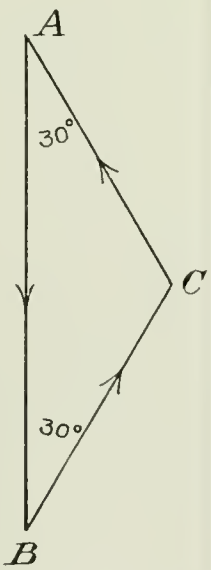



Fig. 62.

From any point B (Fig. 65) construct BC to represent the known vertical force BC.

Now, **since the forces under consideration are in equilibrium, their vector polygon must close.** Therefore, from C and B (Fig. 65) draw lines to represent the directions of the forces CA and AB, respectively. These lines intersect at A. Evidently, CA and AB (Fig. 65) represent the unknown forces CA and AB, the sense marks being continuous from the initial to the final point of the polygon as indicated.

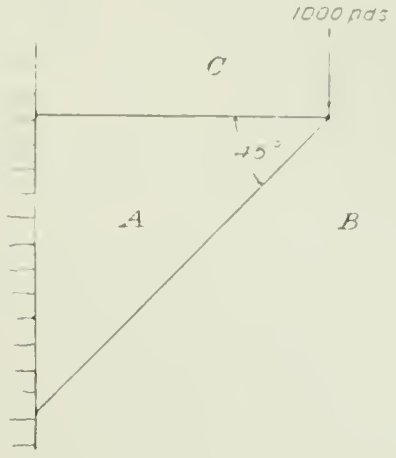



Fig. 63.

The triangle BCA (Fig. 65) is, from construction, a 45° right angled triangle; therefore, since BC represents 1,000 pounds, CA and AB represent forces of 1,000 pounds and 1,000 √2 pounds, respectively.

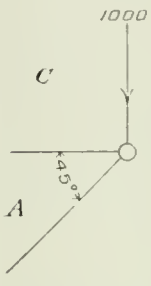



Fig. 64.

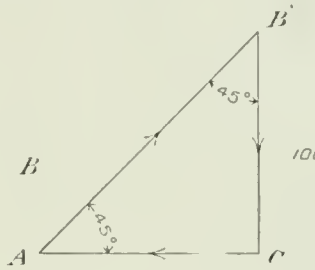



Fig. 65.

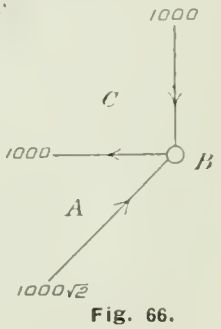



Fig. 66.

By drawing a new statical diagram (Fig. 66) and placing on it all the above deduced quantities, it is seen that the member CA exerts a tensile force and the member AB a compressive force at the point being considered.

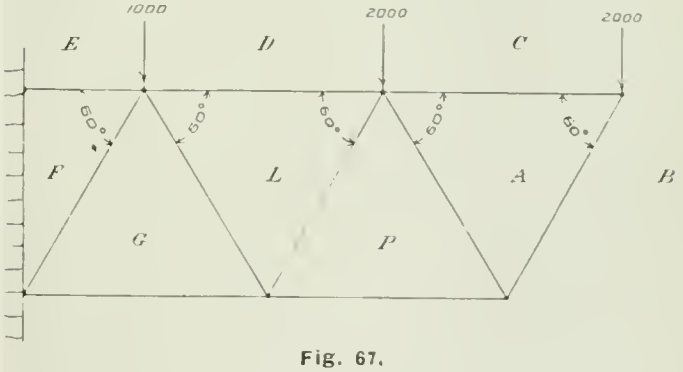



Fig. 67.

The member CA is, therefore, in tension (resists being torn apart) to the extent of 1,000 pounds, and the member AB in compression (resists being compressed) to the extent of 1,000 √2 pounds.

**Find the stress in the members of a cantilever such as indicated in Fig. 67, the panels of which are equilateral triangles.**

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(Continued on page 50.)

# ASTRONOMICAL PAGE

Star Map for November 1st, 1909, 10 p.m.

## STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., NOVEMBER 1st, IN LATITUDE 45° N.

**L. B. Stewart, D.T.S.**

The table below gives the apparent places of the brightest of these stars for November 15th at transit across the meridian of 5h W. of Greenwich.

| Star | Mag. | R. A. h. m. s. | Decl. ° ′ ″ |
|---|---|---|---|
| α Andromedæ | 2.1 | 0 03 43.3 | + 28 35 40 |
| β Cassiop. | 2.4 | 0 04 22.8 | + 58 39 19 |
| α Cassiop. | 2.5 | 0 35 23.3 | + 56 02 44 |
| γ Cassiop. | 2.3 | 0 51 16.0 | + 60 13 52 |
| α Ursæ Min. (Polaris) | 2.1 | 1 27 27.1 | + 88 49 37 |
| α Arietis | 2.2 | 2 02 05.4 | + 23 02 16 |
| α Tauri (Aldebaran) | 1.1 | 4 30 45.0 | + 16 19 48 |
| α Aurigæ (Capella) | 0.2 | 5 10 11.9 | + 45 54 26 |
| β Ursæ Maj. | 2.4 | 10 56 23.0 | + 56 51 51 |
| α Ursæ Maj. | 2.0 | 10 58 08.8 | + 62 14 09 |
| γ Ursæ Maj. | 2.5 | 11 49 03.8 | + 54 11 41 |
| δ Ursæ Maj. | 3.4 | 12 10 56.2 | + 57 31 56 |
| ε Ursæ Maj. | 1.8 | 12 50 01.8 | + 56 26 53 |
| ζ Ursæ Maj. | 2.1 | 13 20 15.6 | + 55 23 44 |
| η Ursæ Maj. | 1.9 | 13 43 57.1 | + 49 45 46 |
| α Lyræ (Vega) | 0.1 | 18 33 51.3 | + 38 42 06 |
| α Aquilæ (Altair) | 0.9 | 19 46 21.5 | + 8 37 48 |
| α Cygni | 1.3 | 20 38 20.2 | + 44 57 38 |
| β Pegasi | 2.4 | 22 59 23.6 | + 27 35 43 |
| α Pegasi | 2.6 | 23 00 15.6 | + 14 43 15 |

### Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on November 1st, 1909, for places in longitude 5th (= 75° W.) and at certain standard times T:

| T | Sid. Time | Lat. = 44° | | Lat. = 48° | | Lat. = 52° | |
|---|---|---|---|---|---|---|---|
| P.M. | | A | a | A | a | A | a |
| h. m. | h. m. s. | ° ′ ″ | ″ | ° ′ ″ | ″ | ° ′ ″ | ″ |
| 8 00 | 22 42 39.8 | 1 05 24 | −19 | 1 10 28 | −21 | 1 16 47 | −23 |
| 8 30 | 23 12 44.7 | 0 55 09 | −21 | 0 59 2 | −23 | 1 04 46 | −25 |
| 9 00 | 23 42 49.6 | 0 43 54 | −23 | 0 47 1 | −25 | 0 51 35 | −27 |
| 9 30 | 0 12 54.5 | 0 31 51 | −24 | 0 34 20 | −26 | 0 37 26 | −28 |
| 0 00 | 0 42 59.5 | 0 19 14 | −25 | 0 20 44 | −27 | 0 22 36 | −29 |
| 10 50 | 1 13 04.4 | 0 06 15 | −26 | 0 06 45 | −27 | 0 07 21 | −30 |
| 11 00 | 1 43 09.3 | 359 53 10 | −26 | 359 52 38 | −27 | 359 51 58 | −30 |
| 11 30 | 2 13 14.3 | 359 42 13 | −25 | 359 38 40 | −27 | 359 36 44 | −29 |
| 12 00 | 2 43 19.2 | 359 27 36 | −24 | 359 25 04 | −26 | 359 21 55 | −28 |

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.

T = the time for November 1st.

CUT HERE FOR REFERENCE.

L = the longitude.

D = number of days elapsed since November 1st.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° ( = 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on November 8th.

Here the interpolated value of the azimuth for 8h 30m is 1° 01′ 06″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 ( = 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

### Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) — (L — 5h)$.

Where

S = the required sid. time.

S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\alpha — S)\ (1 — 0s.16)$.

Where

T = the required standard time of transit of the star, and

T′ = the tabular time corresponding to S′.

$\alpha$ = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star α Pegasi is observed at the watch time 8h. 10m. 17.5 sec. at the same place and date as above; to find its correction on standard time.

| | | h. | m. | s. |
|---|---|---|---|---|
| Sidereal time, 8h. 10m. 17.5s. (table) | = | 22 | 42 | 39.8 |
| 7 × (3m. 56s. 555) | = | | 27 | 35.9 |
| | | 23 | 10 | 15.7 |
| Difference of longitude | = | | 20 | 00 |
| S | = | 22 | 50 | 15.7 |
| R.A. of star | = | 23 | 00 | 15.6 |
| α — S | = | | 9 | 59.9 |
| 10 × 0s.16 | = | | | 1.6 |
| Equivalent mean time interval | = | | 9 | 58.3 |
| T′ | = | 8 | 00 | 00 |
| T | = | 8 | 09 | 58.3 |
| Watch | = | 8 | 10 | 17.5 |
| Watch fast | = | | | 19.2 |

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

## VIRGINIA STATE HIGHWAY COMMISSION.

(Continued from Page 494.)

Should voids be discovered when the forms are taken down, the defective work shall be removed and the space filled with one to one cement mortar. The exposed surfaces shall be smoothed over with a neat Portland cement grout, laid on with a brush, until a smooth surface is secured.

Centres and forms, satisfactory to the Engineer, shall be provided by the contractor. They shall be of planed lumber and shall fit the curves and shapes of the work. The sheathing shall be laid tight, and shall be made clean before using.

The centres shall be true to the lines, satisfactorily supported and firmly secured, and remain in place as long as the Engineer may direct, or replaced by new ones if deemed necessary by him. Metal for reinforcement to be of section and quality approved by the State Highway Commissioner.

When work is done under such conditions that the mortar is liable to freeze, the necessary means shall be provided for thoroughly heating all materials, and for thoroughly protecting the masonry from damage by rain and frost during and after laying.

During warm and dry weather, and whenever the Engineer may direct, all newly built concrete shall be kept well shaded from the sun, and well sprinkled with water until properly set.

## RAILWAY ORDERS.

(Continued from Page 487.)

8375—October 12—Approving plans and specifications for the improvement of Trigger Drain, prepared by George A. McCubbin, C.E., same to be constructed under and across the railway and lands of the Canada Southern Railway in the village of West Lorne, Ont.

8376—October 15—Authorizing the G.T.R. to construct, maintain and operate branch line to the premises of the Colonial Fur Company, County Middlesex, Ont.

8377—Ordering that the Corporation of the village of Thamesville, Ont., be made a party to the proceedings in re complaint of E. F. Best, of Thamesville, re dangerous condition of level crossings of G.T.R. and Wabash Railway Company in said village.

8378 — October 18 — Approving Standard Passenger Tariff C.R.C. No. 20 of the N.B. So. Railway Company.

8379—October 18—Approving character of work and construction of drain proposed by the Municipal Council of the Tp. of Harwich, County Kent, Ont., under the track of the Lake Erie and Detroit River Railway, now operated by the P.M.R.R.

8380—October 19—Granting leave to the Quebec, New Brunswick and Nova Scotia Railway to construct its railway across public road between parishes St. Foye and Lorette, County Quebec, P.Q.

8381—October 15—Granting leave to the C.P.R. to construct its spur to the waterfront in the town of Parry Sound, Ont.

8382—October 19—Granting leave to the C.P.R. to open for the carriage of traffic that portion of the double track of the Ontario & Quebec Railway, Smith's Falls Section, mileage 41.6 to 44.9.

8383—October 15—Granting leave to the C.P.R. to construct an extension of its railway across Arthur Street, village Elmira, Ont.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Oct. 21 | | STOCK QUOTATIONS — TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Oct. 21 '08 | Price Oct. 11 '09 | Price Oct. 21 '09 | Sales Week End'd Oct 21 | Price Oct. 2 08 | Price Oct. 14 09 | Price Oct 21 '09 | Sale Week End'd Oct.21 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,147,000 | 1,693,000 | | 186¾ | 185¼ | 183¾ | 80 | 175¼ | 175 | 186 | 195¼ | 183¾ | 183¼ | 500 |
| Canadian Northern Railway | 2,986.9 | | | 328,100 | 275,800 | | | | | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 964,674 | 841,160 | | | *1st. pref. 108¾, 3rd pref. 57¼, ordinary 23¾ | | | | | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | 32,854 | 19,504 | | | | | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 75,100 | 70,562 | | | | | 190 | 189½ | 212½ | 210½ | 211½ | 210½ | | 987 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,754 | 67,665 | 104½ | | 124 | 124 | 291 | 101¼ | 104¼ | 125½ | 124¼ | 125 | 123¼ | 602 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 166 | 187¼ | 185 | | 1. | | 163¾ | | | | | |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## GRAND TRUNK RAILWAY HALF-YEARLY REPORT.

The report of the G.T.R. for the half-year ending June, 1909, has been distributed.

The gross receipts for the first six months of 1909 are given as £2,866,468 8s. 7d. as against £2,854,787 for the first six months of 1908, some £12,000 of an increase.

The working expenses have also increased from £2,069,144 in 1908 to £2,079,196 in 1909.

The expenditure during the first six months of 1908 was 72.47 per cent. of the gross receipts and during 1909, 72.54 per cent. And the expenditure per train mile was in 1909 $1.10 per train mile against $1.05 in 1908, an increase of five cents per mile.

### Train Mileage.

The train mileage for the half-year compares with that for the half-year ending 30th June, 1908, as follows:—

| Description of Mileage. | 1909. | 1908. |
|---|---|---|
| Passenger | 4,086,109 | 4,304,902 |
| Freight | 4,752,765 | 4,929,803 |
| Mixed trains | 240,528 | 226,051 |
| Total | 9,079,402 | 9,460,756 |

The total length of roadway is now 3,536 miles, with 709 miles of second track and 1,286 miles of siding, making a total of single track of 5,531 miles of all steel rails.

The cost per train mile for train, engine and cars is as follows:—

| Half-year ended | Total Expenditure. Dollars. | Train. Mileage. | Rate of Expense per Mile. Train. Cents. | Engine. Cents. | Car. Cents. |
|---|---|---|---|---|---|
| June, 1909 | 4,150,751 | 9,079,402 | 45.72 | 35.91 | 2.83 |
| June, 1908 | 4,337,989 | 9,460,756 | 45.85 | 35.65 | 2.94 |

| | Passenger Trains. | Freight Trains. | Mixed Trains. |
|---|---|---|---|
| And the average number of cars moved per train was | 4.5 | 26.7 | 6.8 |
| And for the corresponding period. | 4.3 | 25.8 | 6.6 |

The comparative cost of repairs per train, engine and car mile was:—

| Cost per Mile. | Repairs and Renewals of Locomotives. 1909. Cents. | 1908. Cents. | All Repairing Charges, including Shop, Machinery, Tools and Marine Equipment, etc. 1909. Cents. | 1908. Cents. |
|---|---|---|---|---|
| Train | 11.37 | 7.85 | 12.98 | 11.12 |
| Engine | 8.94 | 6.11 | 10.19 | 8.65 |
| Car | 0.70 | 0.50 | 0.80 | 0.71 |

The cost of repairs per car mile on the rolling stock was:—

| Half-year ended | Cost per Mile. Car. | Train. |
|---|---|---|
| June, 1909 | 0.705 | 11.39 |
| June, 1908 | 0.565 | 8.81 |

### Expenses, Mileage, etc., in Motive Power Department.

Mileage.—000's omitted. Thus 731 = 731,000.

| | Passenger Trains | Freight Trains | Mixed Trains | Total Train Miles | Switching, Piloting and Light Running | Total Train Miles | Company's Engineering and other Trains | TOTAL MILES |
|---|---|---|---|---|---|---|---|---|
| Total 1908 | 4,304 | 4,929 | 226 | 9,460 | 2,708 | 12,169 | 305 | 12,474 |
| Average for 6 mth's, 1908 | 717 | 821 | 37 | 1,576 | 451 | 2,028 | 50 | 2,079 |
| Average No. of Cars per Train | 4·3 | 25·9 | 6·6 | 15·6 | .. | .. | .. | .. |
| Total 1909 | 4,086 | 4,752 | 240 | 9,079 | 2,474 | 11,554 | 263 | 11,817 |
| Average for 6 mth's 1909 | 681 | 792 | 40 | 1,513 | 412 | 1,925 | 43 | 1,969 |
| Average No. of Cars per Train | 4·5 | 26·7 | 6·8 | 16·2 | .. | .. | .. | .. |

### Expenses Per Mile in Cents.

| | Engines, Per Engine Mile — Working Expenses: Locomotive Engineers, Firemen, etc. | Fuel | Water Supply | Oil and Sundries | Total Cost of Working | Repairing | Total Working and Repairing | Total Cost of maintaining Car Stock per Train Mile | Cars per Train Mile |
|---|---|---|---|---|---|---|---|---|---|
| 1908 | 7.76 | 18.10 | .62 | .52 | 27.00 | 8.65 | 35.65 | 8.81 | |
| 1909 | 7.90 | 16.74 | .63 | .45 | 25.72 | 10.19 | 35.91 | 11.39 | |

The listed departments required the following per cent. of gross revenue:—

| | |
|---|---|
| Maintenance of way and structures | 9.50 |
| Maintenance of equipment | 8.25 |
| Car department | 7.42 |
| Traffic expenses | 3.18 |
| Conducting transportation | 39.60 |
| General expenses | 3.11 |

Altogether the report is satisfactory and encouraging, and now that the president of the Grand Trunk Railway system is to live in Canada—now that the head of this great system is to be near to the work, we expect coming reports to show even greater progress

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**New Brunswick.**

FREDERICTON.—The city road committee is calling for tenders for 1,500 tons of the variety of trap rock which is taken from the Douglas and Kingsclear quarries.

**Nova Scotia**

HALIFAX.—Tenders will be received until Monday, November 1st, 1909, for the following fire hose:—3,000 ft. 2½ inch fire hose, 300 ft. 1 inch chemical hose, 10 ft. 4 inch suction hose, 20 ft. 2½ inch suction hose. All with couplings complete and suitable for Halifax Fire Department. L. Fred Monaghan, city clerk.

**Quebec.**

MONTREAL.—Tenders will be received up to Monday, November 1st, for boilers for the electric plant of the town of Verdun. Mr. Charles Brandeis, consulting engineer, 4 Phillips Place, Montreal.

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

MONTREAL.—Tenders will be received up till noon on Tuesday, the 2nd November, for the supply and delivery of 12,00 tons of soft steam coal for the Low Level Pumping Station Point St. Charles. L. O. David, city clerk.

MONTREAL.—Tenders will be received up to Wednesday, 3rd November, for the construction of the undermentioned buildings and fences in the Corporation Yard at the south-east corner Huntley and Defleurimont Streets, viz.: 1. A dwelling house and stable; deposit required, $1,000. 2. An office building and storeroom; deposit required, $2,000. 3. A shop building; deposit required, $2,000. 4. A fence around the above yard; deposit required, $500. Plans and specifications may be seen at the office of Mr. R. L. Montbriand, architect, 230 St. Andre Street. L. O. David, city clerk.

**Ontario.**

KINGSTON.—Tenders will be received at the office of the Secretary, School of Mining, where plans and specifications may be seen, and at the office of the undersigned up to Saturday, November 10th, for the erection and completion of a Chemistry Building for the Governors of the School of Mining. Power & Son, architects.

LONDON.—Tenders will be received until Wednesday, November 10th, for underground conduit and cable system for electric light and power supply. Tenders are also invited until November 22nd on the transformers, motor generator set, voltage regulators, switchboards, lightning protectors, instruments, arc and incandescent street lighting systems, and other electrical apparatus. Address, Mr. E. I. Sifton, Electrical Engineer, City Hall.

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received until November 2nd for the construction of a gate house to be built over the South Tunnel Shaft at the Island. Joseph Oliver (Mayor) Chairman, Board of Control. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Wednesday, 10th November, for all the cherry, birch, maple, spruce, hemlock and other classes of timber, estimated to contain over fifty million feet of hardwood, and over fifty million feet of soft wood, on a tract situated on the Georgian Bay at Beaverstone River. McCarthy, Osler, Hoskins & Harcourt, Toronto, Solicitors.

WESTON.—Tenders will be received until Monday, November 1st, for (a) laying 23,600 lineal feet of water mains, (c) steel water tower and foundation, (d) cast iron pipes and special castings, (e) fire hydrants, gate valves, valve boxes, etc., (f) sedimentation basin. R. J. Bull, Reeve; Willis Chipman, consulting engineer, 103 Bay Street, Toronto.

**Manitoba.**

BIRTLE.—Tenders will be received till November 1st, for the building of a Howe truss, 90 ft. span bridge over the Bird Tail, five miles southwest of Birtle, on cement piers now constructed. Plans and specifications at Public Works Department, Winnipeg, or at the Printing Office, Birtle. Bridge to be completed by January 1st, 1910. Write Wm. Lidster, Birtle, Man.

WINNIPEG.—Tenders for supply of sewer pipe and specials will be received up to Monday, November 1. M. Peterson, secretary, Board of Control.

WINNIPEG.—Tenders will be received up to Tuesday, 2nd November, for the erection of 5,000 lineal feet wire fencing required for Waterworks Park (McPhillips Street). Tenderers are requested to submit design and sample of fencing. J. H. Blackwood, secretary, Public Parks Board.

WINNIPEG.—Tenders will be received up to Monday, November 1st, for supply of one motor hose wagon for the Fire Department, capable of carrying 2,000 feet of 2½ in. cotton, rubber-lined fire hose, approximate weight 2,200 lbs., and six men, approximate weight 1,020 lbs. M. Peterson, secretary, Board of Control.

**British Columbia.**

VANCOUVER.—Tenders will be received until November 9th, for building a large bridge over False Creek, this city. Messrs. Waddell & Harrington, consulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

## CONTRACTS AWARDED

**Ontario**

LONDON.—For laying mains and supplying material, Mr. Chris. Leathorn has been awarded a contract by the Water Commissioners.

NEW LISKEARD.—The McKnight Construction Company have been awarded the contract for laying a sewer on Armstrong St. here, at $8,468.

FORT FRANCES.—Mr. W. W. Canaday has been awarded the contract for the electric light poles.

ST. THOMAS.—Messrs. Ingram & Davey have received the contract from Messrs. D. J. Wilson & Sons, architects, Chatham, for the metal work on the Grace Methodist church.

PETERBORO.—The Water Commissioners have decided to enter into a contract with the Wm. Hamilton Co., of this city, to supply a pump, waterwheel and travelling crane and to have the company remove the present pumps and install them in the new pump-house when advisable.

**British Columbia.**

VICTORIA.—The Hinton Electric Company of Victoria was awarded the contract for the installation of an improved system of fire alarms and call bells in the public schools.

VICTORIA.—Mr. J. H. B. Rickaby, who represents British manufacturers, will probably receive the contract for 87,500 feet of Mannesmann steel pipe, which is required for

waterworks purposes. Mr. Rickaby's tender is $40,928. Leeming Brothers submitted two tenders, one for $52,536 and another for $41,557, while the Gardiner-Johnston Company, of Vancouver, tendered but did not state a definite figure. The tenders of the two latter were not according to specifications.

NEW WESTMINSTER.—Mr. W. W. Forester, of this city, has been awarded a contract by the British Columbia Electric Railway for the erection of repair shops 90 x 180.

NEW WESTMINSTER.—The contract for reflooring the roadway on the upper deck of the New Westminster Bridge here has been let by the Provincial Goevrnment to Messrs. Broley and Martin, of Fernie, B.C., at $22,000.

VANCOUVER.—At a recent meeting of the Board of Works tenders for a trunk sewer on Clark Drive were opened, the bids being as follows: M. P. Cotton, concrete and brick, $24,800; Palmer Bros. & Henning, concrete and brick, $16,500; Paterson Timber Company, concrete and brick, $19,922. For a series of tile-pipe sewers in the Cedar Cove section tenders were submitted as follows: George Hull, $25,450; A. H. Gordon, $23,900; Paterson Timber Company, $25,982. All the bids were referred to the engineer.

## RAILWAYS—STEAM AND ELECTRIC.

### Quebec.

MONTREAL.—The first cars for the new electric road, which is to connect Montreal with St. Lambert, across the St. Lawrence, by the Victoria bridge, have been received by the Montreal & Southern Counties Railway. The tracks and terminals are now nearly complete, and a trial run will be made shortly.

MONTREAL—It is announced by the Mackenzie & Mann interests that next spring they will start work on a new branch of the Quebec & Lake St. John Railway from Roberval running northwesterly to the recently-opened mining district of Chebeugamou. The line will be pushed through during the summer to Chute a l'Ours, thirty miles northwest of Roberval. At this point there are very extensive water powers, which are owned by the Provincial Government.

QUEBEC.—The progress made upon the work of construction of the National Transcontinental Railway, in connection with the Quebec division, east and west, on both the south and north shores of the St. Lawrence during the past summer season, from April last, is remarkable. The track is laid from the Cap Rouge site of the Quebec bridge to the Charest River, with the exception of some small gaps aggregating four miles, which will be closed by the 15th of November. This is fifty miles from Quebec, and from this point 150 miles of the railway is in operation for construction purposes. From this point the track is being laid to the second crossing of the St. Maurice River, 188 miles from Quebec, and will be altogether completed by the 28th of December. The bridge over the second crossing of the St. Maurice will be constructed during the coming winter and open to traffic next spring, which will allow track-laying to proceed. The grading is now active for 25 miles west of Weymontachene, a Hudson's Bay post on the upper St. Maurice River, which is the point where the road runs west to strike the north end of Lake Abitibi, where the G. T. P. Construction Company have a contract for 200 miles of the road and are building both east and west of Lake Abitibi, making good progress. The construction work on the south shore is also making good progress, and the work all under way from Moncton to Levis. The track is laid in pieces all along the route, to enable the steamshovels to work. The steamshovels, engines, and cars used on the construction, are taken to pieces and forwarded over winter roads from 20 to 30 miles. The track has already been laid from the 13th mile from Levis to the 45th mile, a stretch of 32 continuous miles, and in addition a couple of miles from the Chaudiere have been tracked.

### Ontario.

TRENTON.—A sub-contract has been let by the C.N.R. to Dibona and Orlando Bros. for the construction of the section between Trenton and Brighton, and they have brought their plant from Quebec to start work at once. They will begin at the Trenton end. A steel bridge with a swing span will be erected across the Trent river.

### Manitoba.

BRANDON.—A new heating plant for the C. P. R. depot is to be installed at an estimated cost of $10,000.

BRANDON.—Extensions to the yards of the C. N. Railway at this point, are being planned.

WINNIPEG.—The first through train to Wetaskiwin over the new main line of the C. P. R. left for the west on October 20th. The regular schedule will not be commenced for a couple of months.

### Alberta

EDMONTON.—Mr. George H. Webster, contractor for the first fifty miles of the Tofield to Calgary branch of the G. T. P., expects to have the grading completed as far as the Battle River and that the steel laying will probably be finished as far as the town of Camrose very soon. Mr. Webster said that his men began working about the first week in July and have been doing record work ever since. Between the Battle River and Tofield there is a mile of grading to be done into Tofield.

LETHBRIDGE.—The bridge over the Old Man River on the Lethbridge-MacLeod cut-off was completed ready for trains on October 22nd. Some riveting and ballasting is all that remains to be done. The line will be used some time next week.

EDMONTON.—On the Grand Trunk Pacific west of Edmonton, the construction gangs all the way along from the Pembina river to Tete Jaune Cache are working steadily, and at the rate at which the work is progressing the line will undoubtedly be graded and ready for steel by next fall. The bridge over the Pembina river is almost half completed, and will likely be finished by the end of November.

EDMONTON.—Under the name of the Pine Pass Railway, a company is seeking incorporation to build a railway from Edmonton through the northern wilds to Fort McGeorge, a Hudson's Bay post. The company is reported to have strong backing, financially, and as soon as the charter has been obtained construction will be commenced.

### British Columbia.

NEW WESTMINSTER.—An interlocking switch which derails a train on the approaches if it goes against the signals, has arrived for instalation on New Westminster bridge.

KAMLOOPS.—The Canadian Northern will be in Kamloops within two years' time and will go down the Thompson and Fraser rivers to the coast. It is not definitely determined as yet whether the terminals will be located at New Westminster where the company has secured water frontage. The Grand Trunk Pacific will go south from Kamloops and on through the Nicola and Similkameen across the Hope Pass to the coast. The engineers who are now at work along Campbell Creek and in the Stump Lake and Nicola districts report splendid progress and it is understood that a survey will be carried as far as the Hope Pass this fall. The location of the Canadian Northern from Kamloops to Agassiz is now completed according to Superintendent White, who is in Kamloops. The line runs along the south side of the river. The Kettle Valley railway will be hooked up between Midway and Coutlee thus giving direct communication between the coast and Boundary.

PHŒNIX.—The C. P. R. is considering plans for the electrification of its line from Phœnix to the Granby Smelter. Power will be supplied by the West Kootenay Power and Light Company.

VANCOUVER.—The contract for the Lynn Creek line has been let to the Paterson Timber Company by the British Columbia Electric Railway. The equipment is already being assembled. Work will be commenced this week or next and will be then pushed forward as rapidly as possible. The line will be two and a half miles of single track and the Paterson Lumber Company will do all except put up the overhead work. The construction of the track will probably take from seventy to ninety days.

KAMLOOPS.—It is stated that the C. N. Railway intends to commence tracklaying operations from Kamloops, north, early next spring.

KAMLOOPS.—The C. P. R. is spending considerable money along the local divisions. At Spence's Bridge large coal chutes have been erected, and all the engines on the division between Kamloops and North Bend will be coaled there. A similar chute will be constructed at Kamloops to coal the engines from the eastern division. The outlay for these improvements will be about thirty thousand dollars. The remodelling and enlarging of the local yards is nearing completion—a work that will cost over fifty thousand dollars.

## LIGHT, HEAT, AND POWER

**Nova Scotia**

DOMINION, C. B.—The civic corporation and the Sydney and Glace Bay Railway, Limited, have entered into a five years' agreement whereby the tram company is to deliver current at the rate of seven cents per kilowatt hour at the town line. The town has also arranged with the tramway and telephone companies for the privilege of stringing the transmission lines for their lighting system upon the poles of these companies. The civic body calculate upon the installation of at least 650 domestic and commercial lights and will install fifty 32 candle power incandescent street lights. The price of commercial and domestic supply has not been decided upon as yet.

**Quebec.**

MONTREAL.—The Fire & Light Committee recently made a report to the Council recommending that a contract be entered into with the Montreal Light, Heat & Power Company for the ensuing five years, from January 1st, 1910, at the following maximum rates: 1. Arc lamps per lamp, per year $75. 2. Inc. 65 c.p. lamps, per lamp per year $36. 3. Inc. 32 c.p. lamps, per lamp per year $24.

VERDUN.—The foundation for the new electric power station has been completed and the building is expected to be roofed inside five weeks. There will be no delay during winter months, the machinery being due to operate at the beginning of March.

**Ontario.**

PORT ARTHUR.—The contract entered into by the City Council with the Ontario Hydro-Electric Power Commission, for the delivery of power, will be submitted to the ratepayers for ratification by plebiscite on November 4.

**Manitoba**

BRANDON.—Rapid progress is being made here in connection with the installation of gas. Already 2,500 feet of mains have been laid.

## SEWERAGE AND WATERWORKS.

**Quebec**

MONTREAL.—Mr. John R. Barlow, city surveyor, gives notice that sewers on a number of streets will be constructed immediately.

**Manitoba**

CARMAN.—A new waterworks system has just been completed here, under the supervision of Mr. W. E. Porter.

BRANDON.—The installation of two extra filters at the pumping station has been recommended by the city health officer, Dr. E. C. Beer.

**Alberta**

TABER.—A large force of men, under the direction of Engineer James Thorley, has been busily engaged the past two weeks laying the pipe which is to convey the water of the Belly river to Coal City. Now the pump at the river is in operation testing the strength of the mains preparatory to the filling-in of earth by Contractor R. A. Van Orman.

## FINANCING PUBLIC WORKS.

Debentures were recently sold by the following municipalities:—

**Peterborough, Ont.**—$25,000 bridge on Smith Street.
**Whytewold Beach, Man.**—$1,500.
**Summit Hill, Alta.**—$1,500.
**Kenora, Ont.**—$26,770; schools and local improvements.
**Pembroke, Ont.**—$40,000, $10,000, electric pump and motor, $30,000, bonus Lee Manufacturing Company.
**Kamloops, B.C.**—$8,000 Hospital; $20,000 waterworks; $10,000 local improvements.

**Ontario.**

ST. THOMAS.—In January the ratepayers will be asked to sanction the expenditure of $10,000 on street railway improvements.

BLIND RIVER.—Debentures amounting to $12,000 are offered for sale by John Muncaster, clerk of the municipality.

BARRIE.—Until October 29 tenders are asked for $40,000, $20,000, $10,000 and $3,000 20-year, and $30,000 30-year debentures. Interest 4½ per cent. E. Donnell, town treasurer.

HAVELOCK.—A by-law will be submitted to the ratepayers of Havelock in January next to raise $8,000 for cement walks throughout the town, and $4,000 for a permanent drainage system.

NEW LISKEARD. — The town will probably borrow $10,000 or $20,000 for the construction of a road.

**Manitoba.**

BRANDON.—A by-law authorizing the sale of debentures to the amount of $13,000 was given a third reading and finally passed at a recent meeting of the council.

**Saskatchewan.**

KAMSACK.—This village is advertising for tenders for the purchase of $5,000 debentures.

MAPLE CREEK. — Sewerage debentures aggregating $45,000 are offered for sale until November 3rd by Mr. A. H. Greeley, secretary-treasurer.

MOOSE JAW.—School debentures amounting to $25,000 are offered for sale by J. W. Sifton, secretary of the town of Moose Jaw.

REGINA.—The following villages have been empowered to borrow money for permanent improvements:—

**Melville, Sask.**—$6,000; **Glen Ewen,** $1,000; **Watrous,** $15,000; **Wilkie,** $2,000; **Viscount,** $1,000; **Guernsey,** $1,500.

**Alberta**

NANTON.—This municipality has for sale $16,000 debentures. William Robertson, secretary-treasurer.

**British Columbia.**

REVELSTOKE.—The by-law to borrow $89,000 for the improvement of the power plant, was carried by the biggest majority that ever endorsed a by-law in Revelstoke.

NORTH VANCOUVER.—The ratepayers will vote on a by-law to borrow $128,000, for the construction of a first class steamer and wharves, at an early date, probably November 3rd.

VICTORIA.—The school trustees will ask the City Council to submit to the ratepayers a by-law to provide $150,000 for a new high school.

VANCOUVER.—A by-law providing $42,500 for park improvements may be voted on by the ratepayers in January. It includes $35,000 for rocking the roads, purchasing a roller and erecting a bridge.

VANCOUVER.—By an overwhelming majority, money by-laws aggregating $1,075,000 were passed last Saturday. One by-law is for $675,000, which is to cover the amount necessary to build a new bridge across False Creek at Bridge street, while the other is for $400,000 to meet waterworks expenditures.

## TELEPHONY.

**Manitoba.**

WINNIPEG.—The C. P. R. has completed its telephone system from Cartier, Ont., to Brandon, Man., 1,045 miles.

**United States of America**

LOS ANGELES, CALIFORNIA.—Announcement was made here last week, that the telephone is to supplant the telegraph in train despatching over the entire Santa Fe system. Authority was granted for the equipment of the Albuquerque and Arizona divisions with telephones, and the work will be commenced at once. These two divisions total 887 miles.

## CEMENT—CONCRETE.

**Alberta.**

BLAIRMORE.—W. J. Budd has returned to the Rocky Mountain cement plant and is rushing the work to completion. The overland light railway trestle-work has been completed by Mr. F. Knights, contractor, and the road is now ready for conveying rock to the crushers. The last piece of machinery has been put in and it is thought that cement will be produced by the 15th of November.

## CURRENT NEWS.

**Quebec.**

MONTREAL.—A public competition is open between the architects, surveyors, engineers, draughtsmen, etc., of the city of Montreal for one or more schemes of improvements to St. Helen's Island, and the conversion thereof into a public amusement park. The cost of the work is not to exceed $150,000. Mr. L. O. David is the city clerk.

**Ontario**

BROCKVILLE.—The annual meeting of shareholders of the Brockville, Westport & Northwestern Railway Company, was held this week at the head office of the company here. Only formal business was transacted, such as the reception and adoption of the treasurer's report, election of the directors, etc. For the ensuing year the officers and directors will be as follows: President, E. R. Thomas, New York; vice-president and treasurer, Frederick T. Lewis, New York; secretary and manager, Carsten Heilshorn, New York; general superintendent, W. J. Curle, Brockville.

## MISCELLANEOUS.

**Quebec.**

MONTREAL. — The Edgewater Company have purchased a large area of land near Ste. Anne de Bellevue, which is being sub-divided into lots. They propose to put in cement sidewalks, macadamized roads, sewerage, waterworks and electric light works and have appointed Mr. Chas. Brandeis, consulting engineer, to supervise the entire work. The improvements are estimated to cost $250,000.

**Ontario.**

KINGSTON.—Four properly constructed carts for the removal of garbage and other putrefying matter will probably be purchased by the Council at an early date.

**Manitoba.**

BRANDON.—Mr. Richard E. Speakman, city engineer, recently submitted to the Council estimates of the cost of a sub-way under the Great Northern and Canadian Pacific tracks at Eighteenth Street and of an overhead bridge for a sub-way, including concrete retaining walls and bridges, with a macadam roadway, 9 inches deep and a concrete sidewalk 5 feet wide at the side, the cost was estimated at $120,000. For an overhead, steel plate girder bridge, on steel towers with concrete bases, the bridge to be 30 feet wide, and a sidewalk on steel brackets to the side, five feet wide, with an approach to Pacific Avenue, the clearance to be 22 feet 6 inches above each railway, the floor to be concrete 6 inches thick, the estimated cost was $105,000.

**British Columbia.**

NEW WESTMINSTER. — City Engineer Blackman is preparing a report and plans for an incinerator which will likely be constructed early next year.

NEW WESTMINSTER.—The factory which J. C. McDonald, the successful tenderer for the steel pipe for the city's new water main to Coquitlam Lake, will erect, is to be in operation, it is expected, by the first of next year. A site for the plant has not yet been definitely settled on, but several are under consideration.

## PERSONAL NOTES.

MR. W. M. STEWART has moved to 203 Garry Street, Winnipeg, from Vidir, Man.

MR. G. ARTHUR BENNETT, formerly of New Glasgow, is now with the Canada Iron Corporation, Fort William, Ont.

MR. OWEN W. SMITH, A. M. Can. Soc. C. E., of Galt & Smith, consulting engineers, Toronto, leaves this week for the West, on a business trip.

MR. HERBERT G. BERESFORD, of Dauphin, Man., has been granted a commission as a Manitoba land surveyor, according to the Gazette notices this week.

DR. J. A. AMYOT and DR. G. G. NASMITH, of the Provincial Board of Health, arrived in Lindsay, Ontario, on Wednesday, October 20th. They will inspect the ozone plant.

MR. R. G. McNEILLIE, chief clerk to General Passenger Agent McPherson, has been appointed district passenger agent of the C.P.R. in the Kootenays, with headquarters at Nelson.

DR. CHAS. A. HODGETTS, secretary of the Board of Health for Ontario, was elected first vice-president of the American Public Health Association, at the convention recently held in Richmond, Va.

MR. ARTHUR HEWITT succeeds Mr. W. H. Pearson who has retired from the position of general manager of the Consumers' Gas Company, Toronto, after 55 years' service. Mr. Hewitt has already been with the Gas Company over 20 years.

MR. R. H. KNIGHT, B.A.Sc., of Driscoll & Knight, Dominion Land Surveyors, returned to Edmonton a few days ago after completing the survey of eight townships in the Onion Lake district, on the Saskatchewan side. Mr. Knight was away about four months.

MR. W. S. DREWRY, C.E., B.C.L.S., of Nelson, B.C., has been appointed chief water commissioner for the province, under the terms of the Water Act, passed last session, and assumes office immediately. Mr. Drewry was elected to associate membership in the Can. Society of Civil Engineers in June, 1887.

MR. W. S. CALVERT, M.P., for West Middlesex since 1896, has been appointed member of the National Transcontinental Railway Commission, to fill the vacancy caused by the death of Mr. Robert Reid. Mr. Calvert is 50 years old and was born in the Township of Warwick, in Lambton County. He was educated at the public school there, and later attended Watford Seminary. During the early part of his career Mr. Calvert was reeve of Metcalfe, and warden of Middlesex.

## ENGINEERS' CLUB OF TORONTO.

The belief that the near future will see the earth circled in eighty hours by flying machines was expressed by Mr. J. R. d'Almeida before the Engineers' Club of Toronto last Thursday evening. Mr. d'Almeida has an idea of his own, and he believes he has the final solution of aerial navigation. After the manner of a bird will his ideal machine fly. It will be self-righting, and will travel any distance without the least muscular effort by the mere extension of its wings. This will mean crossing the Atlantic in about twelve hours and circling the globe in less than eighty hours. Mr. A. B. Barry, president of the Club, occupied the chair.

## MARKET CONDITIONS.

Montreal, October 28th, 1909.

The buying movement for iron in the United States continues in full force and surprises even those who have been looking for activity. The buying, however, is not uniform in all branches of trade, first one and then another branch being affected by it. Illustrating the heavy orders still coming in for semi-finished material, it is worth reporting that the average daily orders taken by the subsidiary companies of the United States Corporation during the first half of October amounted to about 84,000 tons. Some look for a period of dullness to follow, unless the railways give out good orders. These continue to be more of a factor than ever. Last week, the railway companies placed buying orders for 15,000 new steel cars and orders are now pending for 8,000 more, besides which, contracts for steel rails, aggregating 25,000 tons, have been given out. The structural steel business is also active, some 80,000 tons having been placed under contract this month, and some 150,000 tons being still under discussion. Plates and shapes and bars are firmly held and advances for next year's deliveries are taking place. The market for billets is also strong.

The English situation, while showing a moderate improvement, is yet without any decided tendency. Stocks of pig iron continue to accumulate, but as the enquiry for shipment to American points is rapidly becoming more constant, it is hoped that sales will be arranged and stocks depleted by resulting shipments. The German and Belgian situation is showing improvement, and European conditions, generally, are looking better, but there is nothing like the upward tendency that is such a noticeable feature on this continent.

In Canada, conditions continue remarkably good. Not only is the volume of business showing a steady increase but prices continue to look upwards. Many foundry interests have covered for their supplies of raw material for the six months, but the trade, generally, is short of pig iron. Those who have covered are now enquiring as to prices for delivery after the first of April next, and it is quite likely that heavy buying will be done on such deliveries within the next two or three weeks. Selling interests are, however, not at all anxious to make contracts for future deliveries, and are declining to submit figures for distant deliveries.

There is considerable activity going on in the market for finished and semi-finished products, but the changes in the market are slow in coming. Some lines have shown practically no change since the beginning of the present year and are not likely, now, to show any change until the close. On the whole, the market is firm, although some lines show a disposition towards easiness, there being special reasons for this, in each instance. The general hardware market is in excellent shape, there being a very e[illegible]

couraging demand from all quarters at the present moment. This demand will probably continue until the close of navigation.

Following is the list of prices:—

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.** The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows:—¾-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14½ to 14¾c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.50 to $3.60.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $8.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.45; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 33½ to 34c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, 28th October, 1909.

Founders and bridge-builders are well occupied, engine works, too, are busy. As a consequence the demand for both pig and structural iron has been brisk. Blast furnaces especially find the demand more than they can keep pace with. Coke has gone up, and if ore advances, as seems likely, there must be an advance in pig before long. In Britain the feeling in both iron and steel is upward, though price at present shows no marked advance. In the United States an increase in quotations has already been made.

Manufacturers and merchants are, as a rule, busy. A good fall trade follows, naturally, an unusually good harvest, and the retail trade begins to perceive the benefit. Dealers in brick and cement are still filling orders of more or less importance, while lumber dealers are busy enough to dispose them to maintain prices. Building, in the city, continues active.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—The expected advance has come; we now quote, black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.h., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles,

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## WIDE TIRES AND THE HIGHWAYS.

Some years ago we heard a great deal about the advantage of using wide tires for wagons carrying heavy loads. Some municipalities introduced by-laws calling for four and five-inch tires, but usually the by-law did not get past the second reading. Ratepayers could not see the advantage of sustaining immediate loss that good roads might result in future years.

Experiments that have been made go to show great saving in traction effort where wide tires have been used on earth, gravel or macadam roads, and with this saving in traction effort there is a marked improvement in the condition of the road, rolling it smooth, even and making it almost impervious to the rain.

The Missouri Experimental Station gives as a result of a number of experiments the following:—

Three earth roads gave:—

| | |
|---|---|
| 1½-inch tire pull ..... | 80 lbs. |
| 6-inch tire pull ..... | 61 lbs. |
| | 25 lbs. |

Three macadam roads gave:—

| | |
|---|---|
| 1½-inch tire pull ..... | 71 lbs. |
| 6-inch tire pull ..... | 55 lbs. |
| | 16 lbs. |

1½-inch tires gave:—

| | |
|---|---|
| On three earth roads..... | 80 lbs. |
| Or three macadam roads ..... | 71 lbs. |
| | 15 lbs. |

These results go to show that, although there is a large saving on improved roads, yet wide tires show a saving greater than that made by improvements.

In this country we make great talk about highway improvement. We are spending large sums on grading, gravel, and crushed stone. All of which is good. But more attention should be given to the question of width of tires.

If the user can be shown the advantage, the manufacturer will not be long in filling the want.

## A NEW PUMP.

There has been installed at Dudley Port a pump novel in design and economical in operation. This pump depends for its lifting power upon the direct action of a gas explosion, and is the invention of H. A. Humphrey.

The pump, which comprises an iron U tube, is simple, and with few moving parts. The short leg of the U connects with the water supply and the long leg with the delivery tank, or pipe. In the open end of the short leg there is a conical-shaped combustion chamber, which is fitted with valves for supplying gas, air and an exhaust valve. The control of the valves is automatic and interlocking.

The cycle of operation is as follows: The charge of mixed gas and air is ignited by a sparker, and exploding drives the water forward, and water flows in from the suction-tank, and, a slight vacuum being created, more air enters. The water begins to surge back under the static head and compresses the air in the combustion chamber, and the elasticity of the air causes the water to again reverse.

Under test a 16 horse-power plant required 1,063 pounds of coal for every horse-power represented by the water raised, which compares very favorably with the 1.7 pounds required by first-class triple expansion steam pumping machinery.

## EDITORIAL NOTES.

Japan has appropriated $20,000,000 for the building of a Government railway. Canadian contractors and manufacturers of Canadian steel rails should find an interesting field here. Business cannot be done by Canadians in Japan unless they send a representative to that country.

* * * *

Graphical methods of solving engineering problems are being much employed. Diagrams and curves to aid in estimating are in constant use. Once a month we expect to insert diagrams that will be of interest to engineers and contractors. The insert in this issue is not just as perfect as we could wish, but we hope to improve the inserts both in regard to the value of information they contain and also in respect to press work.

* * * *

McGill University has opened a new department in the Faculty of Applied Science—that of Harbor Engineering. Harbor engineering works in Canada are now requiring the services of many men, and McGill is to be congratulated in that she is the first university to take up the work, and because she has been so fortunate to secure an engineer as lecturer in the course so familiar with this class of work and a man standing so high in the profession as Mr. F. W. Cowie, of the Montreal Harbor Commission.

* * * *

## BRITISH COLUMBIA'S RAILWAYS.

(Fred. W. Field in the Monetary Times.)

British Columbia is in need of railways. They are the life of a mountainous country, which has also large and fertile valleys. But mountainous countries do not make easy railroad building. The Canadian Northern has been nursing a transportation proposition in British Columbia for some time past. It hatched the other day, and with it came a brood of trouble. Premier McBride, on behalf of the provincial government, said the road would be guaranteed by them to the extent of $35,000 per mile. Railways have been talked indefinitely on Canada's Pacific coast, so Premier McBride's definite statement was something new. Two of his ministers, Hon. R. G. Tatlow and Hon. F. J. Fulton, who manage between them finance, agriculture and lands, have handed in their resignations, evidently thinking that the day of railroad bonuses has passed. The province needs more transportation facilities than it now possesses, and the final result will probably be a dissolution, the return of the McBride government—for British Columbia prefers railroads to politics—and a guarantee of the Canadian Northern bonds.

## COMING MEETINGS.

**Canadian Society of Civil Engineers (Toronto Branch).** Special meeting, Monday, November 15th at 8 p.m. Address by Mr. Allen Hazen on "Water Filtration."

**American Society of Engineering Contractors.**—Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secretary, Daniel J. Hauer, Park Row Building, New York, N.Y.

**American Society of Mechanical Engineers.**—December 7-10, 1909. Annual meeting New York City. Secretary, Calvin W. Rice, 29 W. 39th Street, New York, N.Y.

**American Street and Interurban Railway Association.**—October 4-8, 1909. Annual convention at Denver, Colo. Secretary, Bernard V. Swenson, 29 W. 39th Street, New York, N.Y.

**National Municipal League.**—November 15-19, 1909. Annual meeting Cincinnati, O. Secretary, Clinton Rogers Woodruff, 705 North American Building, Philadelphia, Pa.

## The Engineers' Club of Toronto

96 KING STREET WEST TELEPHONE MAIN 4977

### Programme for November, 1909

THURSDAY, NOVEMBER 4th.

General Business Meeting.

Consideration of proposed amendments to the Constitution, of which notice was given by Mr. A. F. MACALLUM on October 7th, as follows:

*"Clause 3. MEMBERS. The Club shall consist of members, honorary members, and associates. * **

*"An associate shall be one who is not an Engineer by profession, but whose pursuits, scientific acquirements or practical experiences qualify him to co-operate with engineers in the advancement of professional knowledge; and he shall possess all the rights and privileges of members, except the right to vote or to hold office."*

By MR. T. AIRD MURRAY:

*Clause 8. After the word "members," in the first line, add "and associates."*

*Clause 8. To increase the annual dues for resident members from $5.00 to $7.50 from 1st January next.*

THURSDAY, NOVEMBER 11th.

"Some points in the Construction of the Simplon Tunnel." Illustrated by lantern slides.
*Paper by Mr. Chas. B. Fox, M.A.*

THURSDAY, NOVEMBER 18th.

"Facts and Figures relating to Producer Plant Practice."
*Paper by Mr. M. Chapman.*

THURSDAY, NOVEMBER 25th.

Meeting of the Toronto Branch of the Canadian Society of Civil Engineers.

THE EXECUTIVE MEETS EVERY THURSDAY AT 7.30 P.M.

A. B. BARRY, President, City Hall.
L. J. STREET, Treasurer, 37 Melinda St.
R. B. WOLSEY, Secretary, 25 Lowther Ave.

There are twenty-six Dominion Forest Reserves and National Parks set aside in the public-land area of the Canadian West. Their total area is 10,441,120 acres, distributed as follows:—

| | | |
|---|---|---|
| Manitoba—six reserves | 2,288,160 | acres. |
| Saskatchewan—four reserves | 473,600 | " |
| Alberta—six reserves | 6,209,280 | " |
| British Columbia—ten reserves | 1,470,080 | " |

# HIGHWAY BRIDGE OVER THE MIAMI RIVER AT ELIZABETHTOWN, OHIO.

## The Longest Simple Truss Span Bridge in Existence.

H. C. Tyrrell.*

This bridge is remarkable in being the longest simple-truss bridge span in existence, and was designed by the writer. It has a span of 586 feet between centres of end pins and surpasses in length by 36 feet the longest other span, which is one in the bridge crossing the Ohio River at Cincinnati, known as the Cincinnati and Covington Railway and Highway bridge.

The width of roadway is 30 feet, and as the end posts are 30 inches wide, the distance between centres of trusses is 32 feet 6 inches, which is one-eighteenth of the span. The trusses are divided into 18 panels, 32 feet 6 inches long each, making square panels for the lateral system. The type of truss is the subdivided Pratt, with main panels 65 feet long. The truss depth varies from 80 feet at the centre to 40 feet at the first panel point. The curve of the top chord is a parabola, in straight sections of two panel lengths. Stiff laterals and sway bracing are used throughout. This is an essential feature of the design, and one upon which much of the stiffness of the bridge depends. Lateral and other light struts are built in box form, latticed on four sides. The first panels of the diagonals in the top lateral system are built in the same way. Each of the 33 feet 6 inch panels of the floor system are again subdivided by carrying an intermediate floor beam on two longitudinal beams, one at each side of the bridge. In addition to the benefit of economy in floor framing, the two side beams serve also as chords for the lower lateral system. The longitudinal and cross floor beams are of the same size, and the diagonal laterals are rigidly connected by plates, which fasten to the bottom flanges of both cross and longitudinal beams. The floor joists consist of 6-inch steel beams spaced 2 feet 6 inches apart, elevated on 9-inch corbels. On the steel joist is laid the 2½-inch oak flooring, spiked to six lines of 3-inch by 7 inch oak spiking pieces, with 60 d nails. The wheel guards are 6 by 6 inch oak, bevelled on the inner edge and elevated on 4-inch blocks spaced 2 feet apart for drainage. The bridge was given an initial camber of 3 feet at the centre. On each side of the roadway is a neat railing, made of four angles, latticed in box form. This railing lines up with the inner face of the web posts and fastens to them. The portal as shown on the writer's design is a heavy lattice framework, but it was changed in the shop to one plate construction, as shown in photograph, which does not harmonize with the other light framing. The two lines of heavy floor stringers, which act as wind truss chords, are rigidly attached by bottom bracket angles to the main truss posts. Such portions of the wind chord stresses as are not resisted by these longitudinal side beams, are transferred to the bottom chord eyebars, through these rigid connections.

The Elizabethtown Bridge, H. C. Tyrrell, Engineer.

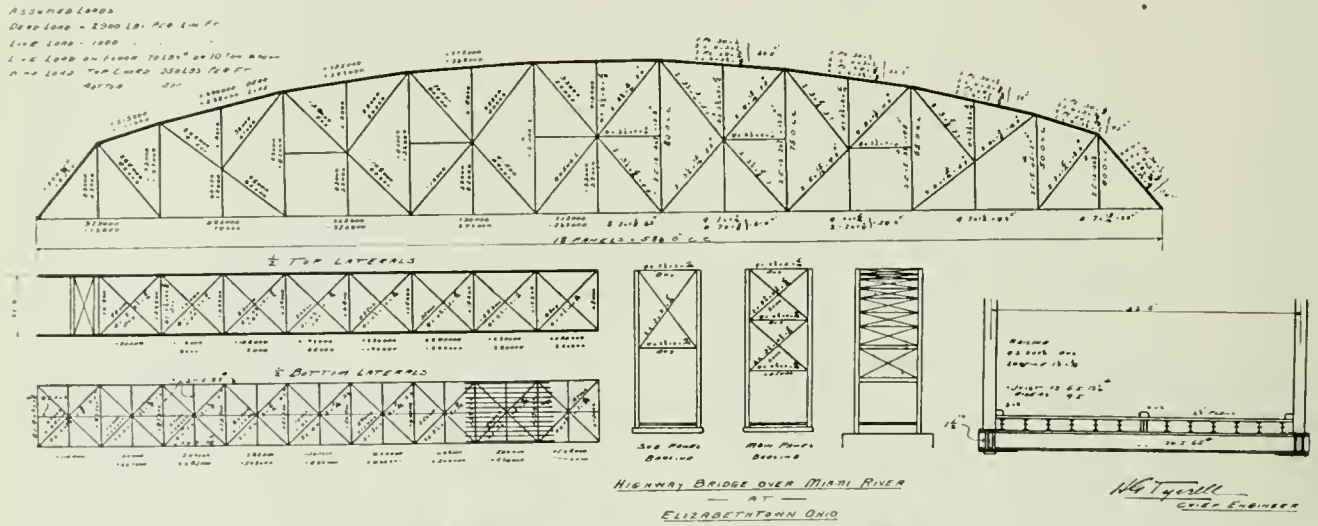
The cross beams at the panel points are suspended by two rod hangers 1½ inches in diameter each, from the bottom chord pins, and at the same time are riveted to the bottom angles on the web posts. This gives a rigid floor beam connection and at the same time reduces the cost of erection. At one end of the bridge are sets of turned rollers and at both ends, the heavy side beams are connected to the shoe boxes, thereby transferring the wind stresses as directly as possible to the masonry. The vertical posts are spliced at the joints of the lateral struts. The minimum thickness of metal used is one quarter inch. The metal throughout is medium steel, conforming to the Manufacturers' standard specifications.

For the purpose of comparison, a table of other long span bridges is given, arranged in the order of their length:

* Bridge Engineer, 1847 Asburg Avenue, Chicago, and author of "Concrete Bridges and Structures," "The Elizabethtown Bridge," etc.

**Table of Long Span Bridges.**

| Date. | Location | River Crossed. | Kind of Bridge Railway or Highway | Span ft. | Engineer. |
|---|---|---|---|---|---|
| 1904 | Elizabethtown | Miami | Highway | 586 | H. C. Tyrrell. |
| 1888 | Cincinnati | Ohio | Railway and highway | 550 | Wm. H. Burr. |
| 1894 | Louisville | Ohio | Railway | 546 | Phoenix Bridge Co. |
| 1889 | Cincinnati | Ohio | Railway and Highway | 542 | |
| 1896 | Philadelphia | Delaware | Railway | 533 | |
| 1890 | Pittsburg | Ohio | Railway | 523 | |
| | St. Louis | Mississippi | Railway | 524 | |
| 1885 | Henderson | Ohio | Railway | 522 | Keystone Bridge Co. |
| 1889 | Ceredo | Ohio | Railway | 521 | T. K. Thomson |
| | Cairo | Ohio | Railway | 520 | Union Bridge Co. |
| | Havre de Grace | Susquehanna | Railway | 515 | |
| 1877 | Cincinnati | Ohio | Railway | 515 | J. H. Linville |
| 1870 | Kuilenburg | Leck River | | 515 | G. Van Diesen. |
| 1902 | New Baltimore | Miami | Highway | 465 | J. H. Hilton |
| 1859 | Saltash | Taular | Railway | 456 | Brunel |
| 1889 | Hawksbury | | Railway | 416 | Union Bridge Co. |
| 1901 | Hamilton | Miami | Highway | 406 | |




**The Elizabeth Bridge, H. C. Tyrrell, Engineer.**

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

8384—October 19—Granting leave to the Manitoba Government Telephone System to erect, place and maintain its wires across the track of the C.P.R. at Brandon, Man., at Hanbury Siding.

8385—October 15—Granting leave to the Rural Municipality of Miniota, Man., to erect, place and maintain its wires across the track of the C.N.R. at P.C. between sections 10 and 11, Tp. 15, R. 25, Man.

8386 to 8391—October 19.—Granting leave to the C.N.Q.R. to erect, place and maintain its telephone wires under wires of the Portneuf Telephone Company, the Bell Telephone Company, G.N.W. Company, and St. Maurice & Champlain Telephone Company at several points in the Province of Quebec.

8392—October 7—Setting forth conditions for the carrying of wires and cables across the tracks of railways under the jurisdiction and subject to the control of the Board.

8393 to 8395—October 5—Directing the V.V. & E. Ry. & Nav. Co. to pay forthwith to Knut Larsen, James Plester, and Jens Gunderson, the sum of $3,875 respectively to the first two and $3,566.25 to the last named on account of land affected by diversion of said railway.

8396—October 19—Authorizing the C.P.R. to open for the carriage of traffic that portion of the double track of the Ontario & Quebec Railway from Finch to Avonmore.

8397—October 15—Refusing application of the C.P.R. for an Order directing that detail plans referred to in Order No. 6968 dated April 27th, 1909, re crossing of Weston Road, town of West Toronto, Ont., by the G.T.R. be amended to show the tower midway between the G.T.R. and C.P.R.

8398—October 19—Granting leave to the Bell Telephone Company to erect, place and maintain its aerial wires across the track of the Michigan Central Railroad on Muir Street, just west of Welland Station. Ont.

8399 to 8401—October 19—Granting leave to the C.N.Q.R. to place its telegraph wires under the wires of the G.N.W. Tel. Company, Bell Tel. Company, Portneuf Tel. Company, and the St. Maurice & Champlain Co. Tel. Company at three points in Province of Quebec, viz., near Portneuf, near St. Severin and near Lachevrotiere, P.Q.

8402 and 8403—October 19—Granting leave to the Saskatchewan Government Telephone System to erect, place and maintain its wires across the track of the C.P.R. near Bienfait, Sask., and at Saskatoon, Sask.

(Continued on page 513.)

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## THE STATE BOARD OF HEALTH IN ITS OFFICIAL RELATIONS TO SANITARY ENGINEERS.

The above forms the title of a contribution by Dr. C. O. Probst to the Quarterly Bulletin, Ohio State Board of Health. Matter is dealt with which should be of great value to those who wish to see the Canadian Provincial Boards of Health become more effective machines in advising and controlling matters of water supply, sewerage, sewage disposal and water purification.

Not until the year 1892 did the Ohio State Board of Health add an engineering department to its constitution; since that date the department has passed upon 655 plans, providing for the construction of sewers, waterworks, sewage and water purification plants.

It is interesting to note that the engineering department was the practical result of the cholera epidemic in Hamburg in 1892, the epidemic being transmitted to the port of New York, causing alarm throughout the whole country. In a revised public health Act the following paragraph at the suggestion of Dr. Probst was adopted:—

"No city, village, corporation or person shall introduce a public water supply or system of sewerage, or change or extend any public water supply or outlet of any system of sewerage now in use unless the proposed source of such water supply or outlet for such sewerage system shall have been submitted to and received the approval of the State Board of Health.

Before this date the Board had often found itself in the position of a consultant; the adoption of the above paragraph, however, made it absolutely imperative that an engineering staff be established to advise the Board with reference to any plans submitted in order to make its administration effective.

The first engineer secured was the late Mr. Flynn, and gradually the work of the Board has extended to a present engineering staff of seven men, all specially trained as sanitary engineers, who may properly be classified as experts.

With the building up of the engineering department and its daily consideration of plans there has been accumulated information and experience of very great value to the designing or constructing engineer. This information finds annual publication in the State Board of Health reports.

The system adopted in passing upon plans for engineering work is as follows:—

Application is made for approval of plans for water or sewerage, or for the purification of one or the other. An engineering blank is usually sent for further information. An engineer then visits the locality and looks over the ground. Plans are finally submitted, which are referred to the engineering department. These come back to the secretary's office with recommendations, which are then discussed. They are then transmitted to the members of the Board, with recommendations approved by the secretary and chief engineer. After consideration by the Board they are adopted, by a majority vote, either as recommended or with such modifications as the majority agree upon.

This final disposition of the plans is not usually reached without correspondence or consultation with the engineer who made the plans.

The engineering department in reviewing the plans frequently find changes or additions desirable. What are deemed essentials are held to, and made a condition of approval.

At times the Board of Health is consulted by municipal authorities before they engage an engineer. It may send an engineer in such cases to look over the ground and give general advice. It insists, however, that an engineer must be finally engaged to prepare definite plans.

From the above it will be at once seen that the State stands in the position of consulting and advising engineer to the many municipalities under its jurisdiction.

Dr. Probst claims that municipalities have been saved great cost by the avoidance of errors, while the system has worked without friction and, in fact, in perfect harmony with the engineering profession.

We must ask the question, Has the time not come when our Provincial Boards of Health must adopt some such sanitary engineering department, which can give useful advice in the first instance to municipalities and form a check upon work, designed perhaps by engineers who may never have seen a sewerage and water supply scheme before.

This class of work is coming more and more into prominence in Canada, and it is somewhat remarkable that the Western Provinces are ahead of the Eastern in recognizing the necessity of governmental engineering advice.

For some time back Dr. Seymour, the Chief Medical Officer of Health for Saskatchewan, has been anxious to put in force the example of the American State Boards of Health, and recently, backed by a strong and progressive Government, with the Hon. W. Scott as Premier, an engineering department on sanitary matters has been formed. Municipalities in Saskatchewan are now in the position to obtain general expert advice from the Government. It is further anticipated that the Government are about to legislate on advanced lines on the whole question of stream pollution and pure water supply in a revised public health Act.

Why an engineering department should not be added, say, to the Provincial Board of Health of Ontario, it is difficult to say. This Board, composed solely of medical men from different parts of the Province, meet regularly to adjudicate and pass upon engineering plans for sewerage and water supply, and are totally

unassisted by any engineering advice. We understand that the permanent secretary, Dr. Hodgetts, recognizes the necessity of such a department. Why it is that the Ministers are so blind to the importance of a progressive and useful movement by which every municipality would benefit in Ontario, we must confess we are at an entire loss to know. General poverty of the Province cannot be made an excuse, and surely there are plenty of examples of the soundness of the policy to warrant its adoption.

**Can. Eng., Vol. 17, Page 261.**

The last paragraph but one in the first column should have read:—

"Professor Dunbar's experiments and conclusions, published since the Commission's report, leave little doubt that Dibden's theory on which he based the contact bed has no scientific basis."

"Professor Dibden" should read "Professor Dunbar." The reference in the first instance is to Dunbar's "Modern Treatment of Sewage Disposal," in which he freely explains by the result of experiments the working of contact beds. The reference in the second instance is to the first conception of contact beds as illustrated by the experimental tanks for the London County Council by Santo Crimp and Dibden.—Ed. San. Rev.

## OZONE TREATMENT.

### Report by Toronto City Engineer to the Corporation.

Referring to the City Clerk's letter of the 18th instant, forwarding a copy of series of enquiries by Alderman R. H. Graham, as follows:—

1. "What experts and other officials recommended to the Board of Control the system of sand filtration for the water supply of Toronto?

2. "Was the question of electric filtration considered? If so, why was it not recommended?

3. "What part of the plant now being constructed would be available in the event of electrical filtration being found suitable and more economical?

4. "In case a change should be adopted from sand filtration to electric filtration after the completion of the present works, what would be the estimated cost of such change?

5. "If the work was suspended and the change made in the near future, what would be the estimated cost?"

I beg to report as follows:—

In answer to the first question, this is fully set out in the report of the Board of Control, No. 15, of May 26th, 1908, and it will also be seen that the report recommending the present system is signed by Charles Sheard, Medical Health Officer; C. L. Fellowes, Deputy City Engineer, and W. M. Harrison, M.D., representative of Board of Control.

In reply to the second question, this can be better answered by the gentlemen who presented the report.

In answer to the third query, I understand the term "electrical filtration" to refer probably to the ozone treatment of water. It is difficult for me to state just what part of the present plant would be available for the ozone process, because I have never had an opportunity of seeing a plant of this description in successful operation, and I do not know precisely of what it would consist. The only ozone plant for treating a municipal supply which I have ever heard of upon the American continent is one at Lindsay, Ont., very recently completed, or perhaps not yet entirely completed. So far as I have heard, ozone treatment has usually been considered and recommended for use on the effluent from filters of the ordinary type. If such should prove to be the case, the whole of the plant now being completed would be available in connection with ozone.

The following statement in the Canadian Engineer of September 10th, 1909, page 288, bears directly upon this point:—

"Disinfection or sterilization may be feasible as an adjunct or accessory to filtration, but as a method of purifying water by itself it is absolutely useless. For instance, if we could obtain a water entirely free from all suspended matter, and containing only organic matter in solution along with the presence of bacteria, then sterilization might be effective. But no such water is ever placed before us to deal with, unless it has been first treated by efficient filtration. We, therefore, find that in all cases of so-called sterilization processes filtration of the water is insisted upon as a primary necessity. We have a case illustrative of this point in Canada at the present time at Lindsay, Ont. At Lindsay there has been recently installed an ozone sterilizing plant. The water is first treated by filtration and then charged with the ozone gas. The filtration is only of a rough-and-ready character, as it is expected that the ozone will do the real work. According to a recent analysis of the treated water, however, we find that the filters remove 67 per cent of the bacteria, and that the ozone only removes a further 57 per cent. of the bacteria from this partially clarified water, the total percentage removal of bacteria from the original water by the combined processes being only 87 per cent., or 8 per cent. below the standard required for mechanical filters.

"In the above case, if the filtration had been of an efficient character to remove the whole of, or practically the whole of the suspended matter, the result might have been satisfactory. Too much was asked of ozone and too little of filtration.

"The fact of the matter is that, up to the present, no data exist which will allow of a pronouncement in favor of sterilization as opposed to filtration. On the other hand, sterilization may be a useful and efficient addition to filtration in certain cases where the original organic impurities are so high as to leave an undrinkable water with a bacterial removal of even over 99 per cent, etc."

In reply to the fourth enquiry, the whole subject of ozone treatment is too indefinite to allow me to make any sort of an estimate of the cost of applying it effectively to the effluent from the plant now under construction.

The fifth question is, perhaps, sufficiently covered by the above.

In connection with the above replies I had the opportunity of consulting Mr. Allen Hazen in regard to same, and he fully concurs in the above report.

## THE NEW FILTRATION PLANT FOR WILKINSBURG.*

### F. B. Leopold, Pittsburg.

The Pennsylvania Water Company, which supplies water to the town of Wilkinsburg and a number of adjacent towns, secures its water from the Allegheny River by means of a series of galleries located in the river bed. As it comes from the galleries it is practically clear and of a rather unusual purity for a supply of this kind. After considerable litigation, however, on the part of the town of Wilkinsburg, in which it was claimed by the municipality that the water was not of the degree of purity that the company should furnish

*A paper read before the Central States Waterworks Association.

under its charter, and could furnish with the proper equipment, it was decided that the company should install a mechanical filtration plant. Owing to the arrangement of the water system and the limited space available at the pumping station, some rather unusual conditions had to be met. The contract was made in May with the Pittsburg Filter Manufacturing Company, of Pittsburg, and the plant was designed by it, in conjunction with the engineers of the water company, and is now under construction. The plant is designed for an ultimate capacity of 20,000,000 gallons per day. The filter beds at present being installed, when fully equipped, will give a capacity of 12,500,000 gallons; only a 10,000,000 gallon equipment is being placed, however, at the present time.

The company has a reservoir at present holding about 16,000,000 gallons, from which the distribution to the system is made. This reservoir is some 450 feet above the pumping station. Owing to the fact that it is undesired to lose any of the available head, it became necessary to design the plant so as to utilize the present reservoir as a clear-water receiving basin; this necessitated the building of the filter plant practically all above ground. In general, the plant consists of two reinforced concrete sedimentation basins, each 150 feet long, 65 feet in width and 22½ feet in depth, each holding something in excess of 1,500,000 gallons. These reservoirs are uncovered and surrounded by vertical walls of heavily reinforced concrete 15 inches in width at the top and 30 inches at the bottom and 17 feet in width of base. As it is necessary for the flow of water to be at a sufficient elevation above the flow line of the present reservoir to provide for the filter operating head, the question of foundation would ordinarily have been one of considerable expense; fortunately, however, the top of the hill on which it is located is composed of shale, and after the surface removal of two or three feet of earth there was formed a most excellent and solid foundation.

The water is pumped direct from the pumping station into the end of each basin, being controlled by a valve to each, and a connection is made to the inlet to the present reservoir, so that the raw water from the pumping station may be supplied to either or both of the sedimentation basins or by-passed through the reservoir, and may also be by-passed directly to the system. Water is distributed across the end of the basin through vertical risers, and will flow horizontally to the opposite end of the basin, passing under a baffle located about in the centre of the basin, and being gathered at the opposite end into a concrete overflow conduit which discharges into a central chamber, from which point it is carried through a 36-inch cast-iron conduit into the filter house and distributed to the filters. The basins are provided with an open overflow 12 inches below the top of the wall, the bottom being sloped with about an 8 per cent. slope to a central sump, from which a valve discharges into a 20-inch washout pipe in the bottom of each basin. The floors of the basins are covered with 10 inches of concrete reinforced with triangular mesh reinforcement, and the walls on the outside are banked up to within three feet of the top all around.

The main filter building consists of a T-shape brick structure 140 feet long and 40 feet wide for the length covering the filters, which are partially covered with flat concrete covers, and 66 feet long over the portion covering the operating-room, machinery and laboratory. This building is one storey in height over the filters; the T-head is two stories above the filter, and has a basement floor on the level of the pipe gallery floor. The building is of buff-colored brick, covered with a Spanish tile roof, the interior finish being of natural wood. The office and laboratory will have metal ceiling and be lined with white glazed tile. The basement floor and all other floors are of concrete, and in this basement is installed the pumping machinery, heating plant and light apparatus. The first floor contains the concrete solution tanks, with concrete orifice tanks for operating them, the office, general reception-room and laboratory. The third floor is to be used as a storage-room for the coagulants, and dissolving tanks are also located here. Communication is had between the three floors by a circular iron stairway. The lower gallery floor is on the level of the ground on the outside of the building, a double door on one end, and the arrangement of the piping in the gallery gives a clear passage from this doorway through the gallery into the basement. The arrangement of the gallery is such that there is a clear space three or four feet wide and high enough for a man to walk through it without meeting obstructions.

The filter equipment is of the contractor's usual general standard type, using a separate water and air manifold system. The water manifold is entirely of cast-iron, with cast-iron laterals and bronze screens; the air manifold is of perforated brass tubing, above which are 8 inches of gravel and 36 inches of sand. The troughs are cast-iron, diamond-shape troughs, so arranged that the flow of water to them does not exceed a travel of 3½ feet, and are designed to carry away not less than ten gallons of water per square foot of area from the bed. The controllers are the closed type, arranged so that the rate of flow can be adjusted from the operating floor, similar to those in use at Lorain, Ohio, and McKeesport, Pa. The valves are all hydraulically operated, and furnished by the Rennselaer Manufacturing Company, and are controlled from marble operating tables, with polished brass trimmings. On the operating table will be located the loss of head gauges. The type of gauge used at this plant will be entirely new in design. It will be of the recording type, with a rectangular chart of convenient form for binding; it will be arranged with double recording pens, one of which will record the actual water level on the filters, the other one recording the loss of head in the effluent, thus giving at a glance the absolute loss of head in each filter, irrespective of any variation in the water level of the filter itself. The purified water is discharged through the controllers into a concrete conduit below the gallery floor, from which it flows to the present reservoir by gravity.

On account of the isolated position of the plant the power conditions were a matter of considerable study. It was not desired to build an independent power station at this point, as it would necessitate hauling all fuel for three miles up a very steep hill, and in winter time over exceedingly bad roads. The conditions at the filter plant require a maximum of power in use a few minutes at a time periodically. After considerable study, it was determined to place a generating plant in the pumping station, about a mile distant, and deliver current over a transmission line to the filters to operate the wash pump, blowers and other power requirements; and in order to secure the most economical electrical installation it was determined to distribute the use of power over a considerable period of time. To do this necessitated the storage of both water and air, and to do this economically required the storage to be at a pressure or elevation practically the same as that of the larger machinery used in direct application. It was finally determined to employ a storage tank of considerable area for water, so that the pumping head would be very little, if any, above that required in washing the filters by direct pumping.

Previous methods of air storage have been the use of pressure tanks, compressing the air in them under high pressure, and then reducing it to that required for use in the filters. This involves an enormous waste of energy, and in studying this question it was ascertained that a method had been devised and a patent application made for a scheme that would accomplish that process. Arrangements were, therefore, made for the use of this arrangement, which consists of an inverted tank on the order of a gasometer, weighted sufficiently to produce the pressure required in the filter beds, then building the tank of such volume as to give the required amount of air. A further study of this revealed the convenience of utilizing the water tank as a seal tank for the air tank. A combination was, therefore, designed, using an inverted air tank on top of the water storage tank.

A small generating plant is to be installed in duplicate at the pumping station, which will be sufficient to furnish power to operate all the motors at one time. This plant will be required to be only about one-third the size of a plant which would be required to operate wash pumps and blowers sufficient to apply water and air directly, the result of this being a very uniform draft on the power station, a more economical use of power, and some economy in the cost of installation. The small pumps for supplying the wash water to the wash-water tank and the air to the air tank will be designed to operate about 50 to 75 per cent. of the time, and will be arranged to operate automatically, so that during the washing of a filter when the water level falls a few inches in the storage tank the motors supplying the wash water, if they are not running, will be automatically started, and will continue to operate until the level is brought up to its normal, when the automatic switch will cut them out. The same arrangement will be applied to the air storage tank, which is designed for volume and not pressure. The motors, therefore, require no care except to see that they are kept in proper shape.

As the plant is located above the point from which water pressure is secured and hydraulic valves are in use, it, of course, becomes necessary to provide pressure for the hydraulic valves; this is done by a small automatic control pressure pump and a surge tank which automatically controls the pressure of the operating cylinders of the valves. These features, as far as the writer's experience or knowledge goes, are unique, and it is believed that it is their first application.

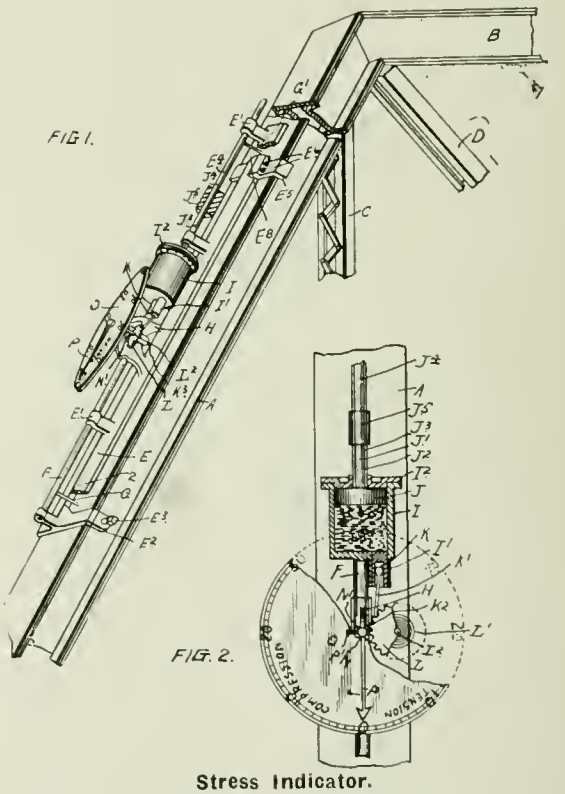
The reagents or chemicals will be stored in the second floor of the building above the office; this storage room will be equipped with an electric hoist for unloading from the wagons and conveying to the storage room. Inside the storage room there will be baskets and a track for delivering the chemicals from the storage space to the dissolving boxes above the solution boxes, which are also located in this room, so that the labor of handling is reduced to a minimum.

The building will be lighted by both gas and electricity. For heating there will be used a low-pressure cast-iron heating boiler in the basement, arranged to use natural gas as fuel.

Immediately beyond the plant there will be a round reinforced concrete basin, into which the water from the washing of the filters will be drained. This basin will provide several hours' sedimentation, so that after washing the filters the wash water carried into it will have an opportunity to settle, the heavy accumulations going to the bottom. The bottom of this tank slopes to the centre, and an outlet standpipe is placed near the centre, so arranged as to drain down to within 4 feet of the bottom; to this will be connected an electrically driven pump, which will take the settled water and pump it back into the sedimentation basin. In this manner it is expected to give the highest economy in the use of the wash water. The location, of course, of this plant and the high head against which all the water is pumped form the only condition which would make for economy in an arrangement of this character, but it is believed that the saving that will be accomplished in this manner will more than justify the expense of the necessary structures for accomplishing it.

## IMPROVEMENTS IN STRESS INDICATORS.

What appears to be a valuable invention has just been patented by Mr. Walter P. Chapman, M. Can. Soc. C.E., resident engineer of the Canadian Northern Railway at Toronto. The device is applicable to both compressive or tensile stresses, and is particularly adaptable for testing the strength of steel construction, bridges and buildings, whereby the amount of tension or compression in pounds to the square inch, under any load, stationary or movable,




Stress Indicator.

may be ascertained quickly and closely, so as to obviate to the greatest extent possible the structure in any of its parts or members exceeding the limit of safety.

The invention consists of an instrument comprising a suitable base, a stationary rod at one end in suitable supports on the base, and a longitudinal adjustable rod held in suitable supports on the base at the opposite end, provided with a pin extending into a hole in the plate of the end post and connected to a hydraulic cylinder, a supplemental cylinder extending from one end of the main cylinder, a minor piston located therein, a gear-wheel mounted on a suitable arbor and having a spring attached thereto to counterbalance the pressure on the minor piston, an arbor mounted in suitable bearings and provided with a pinion meshing with the gear-wheel, a dial suitably supported and indexed at the outer edge, and a hand adjustably supported on the end of the arbor.

Fig. 1 is a perspective view, showing the portion of a bridge and the application of the instrument to measure the compression stresses, while Fig. 2 is a plan view, partially broken away.

In the drawings like letters of reference indicate corresponding parts in each figure.

A is the end post of a bridge or other truss, B is the top chord, C the vertical member, and D the diagonal member. The instrument is shown applied to the end post and the top plate. E is the base of the instrument, having the supports $E^1$ extending out at right angles thereto and projecting bent lugs $E^2$ at one end by which it is held on the post by set screws $E^3$ extending through the same. The opposite end of the base E is provided with an end projection $E^4$, held in place by a suitable set screw. $E^5$ is a clip which fits over the edge of the plate and the base E, such clip being held in position by suitable screws $E^6$ so that it may be readily removed.

F is a stationary rod which is held in the supports $E^1$. G is a pin projecting inwardly from the rod F into a hole in the plate A, the hole being, of course, drilled previously to the instrument being set in place. The pin G extends through a slot 2 in the base E. H is a support intermediate of the length of the base E, and through this the rod F extends. On the end of the rod F is a cylinder I, to which is attached a supplemental cylinder $I^1$ as indicated. The cylinder is partially filled with oil and other fluid, and is provided with a piston J, having the piston rod $J^1$, which extends through the head $I^2$. On the rod J is an index mark $J^2$.

The rod $J^1$ is made in two parts—$J^3$ and $J^4$, which are connected by a coupling $J^5$, provided with a right and left-hand internal thread to fit into the corresponding threads of the portions $J^3$ and $J^4$. The rod $J^1$ is also held in supports $E^1$, and is provided with a pin $G^1$, which extends through a slot $E^8$ in the base plate E into a hole in the top plate of the end post.

K is a piston fitting into the minor piston $I^1$ and connected by a rod $K^1$ to a crank pin $K^2$ on the gear-wheel L, which is held on a suitable anchor $L^2$, journalled in suitable bearings $K^3$. $L^1$ is a helical spring attached at one end to the gear-wheel L and at the other end to the arbor, the normal tendency of such spring being to force the gear-wheel in a direction contrary to what the liquid in the piston I will force the piston K, or, in other words, to compensate the pressure of the liquid on the piston.

N is an arbor journalled in the support H, and having a pinion $N^1$ secured thereto, which meshes with the gear-wheel L. O is a dial plate in which the arbor N is centrally disposed, such dial plate being suitably held in position on the top of the support H. P is a hand secured on the top of the arbor by means of a set screw $P^1$, whereby the position of the hand may be altered as hereinafter explained.

Each half of the dial plate is divided from zero to forty, thus indicating thousands of pounds to the square inch. It will be noticed that the index numbers ten, twenty and thirty when the dial is in the normal position are located on each side of the centre line of the rods F and $J^1$, and that the cypher o and number 40 are arranged diametrically opposite each other on a line with the rods F and $J^1$.

The instrument is placed in position as indicated in the drawing on the end post of the structure. As soon as the load is transmitted to the end post the indicator will show the additional stress upon the same, and the percentage of recovery from such loading after the load is removed.

If the instrument is placed on a lower member of a bridge or structure in which it is desired to ascertain the tensile strength of the member, the hand will move in an opposite direction.

The advantage of this invention will be that the stresses in bridges or structures may be ascertained as erection work progresses. If affixed to a member of an incompleted building, the stresses due to an imposed, stationary or moving load would be registered.

## RAILWAY ORDERS.

(Continued from page 508).

8404 to 8406—October 19—Authorizing the United Fuel Company, Ltd., to lay and thereafter maintain gas pipe under the track of the P.M.R.R. and M.C.R.R. in the Tp. of E. Tilbury, Tp. of Raleigh, and Tp. of Moore, Ont.

8407—October 20—Authorizing the C.P.R. to construct, maintain, and operate branch line of railway, or spur, in the city of Fort William, Ont., on Hardisty Street.

8408—October 20—Approving by-law of the C.P.R. authorizing Jas. Kent the manager of telegraphs of the company to prepare and issue tariffs of telegraph tolls.

8409 October 13—Dismissing complaint of Houghton Lennox, M.P., that the G.T.R. has closed up its freight shed at Allandale, Ont., and that the freight formerly received and delivered at that point has to be received and delivered at Barrie, Ont.

8410—October 12—Granting leave to the C.P.R. to construct its railway across the highways on its main line grade revision, on the Medicine Hat section of its railway, in Province Saskatchewan, from mileage 49.34 to 57.29.

8411—October 13—Dismissing complaint of Township of Seneca, re working of the electric bells installed by the Grand Trunk Railway Company where its line of railway crosses the Port Dover and Hamilton Road, town of Caledonia, Ont.

8412—October 13—Dismissing complaint of J. W. Freeman, of Burlington, Ont., alleging that the watercourse on his property has been blocked by the building by the G.T.R. of a new siding.

8413—October 12—Dismissing complaint of the Municipal Council of the Townhip of Esquesing, Ont., against dangerous condition of the crossing of the G.T.R. on the 7th line in said township.

8414—October 12—Directing that the Michigan Central Rail Road and the P.M.R.R. install each upon its own railway, within 45 days from date of Order, electric bell, at point to be approved by Chief Engineer of the Board, on town-line between Townships Southwold and Dunwich, Ont.

8415—October 15—Directing that the G.T.R. install, within 60 days from date of Order, single arm gate on each side of crossing on Church Street, Police Village of Mimico, Ont.

8416—October 19—Authorizing the C.P.R. to construct, maintain, and operate an industrial spur for Messrs. P. Burns & Company, Dist. Lot 182 C New Westminster District now in the city of Vancouver, B.C.

8417—October 19—Approving proposed change of location of station and the re-arrangement o ftracks of the G.T.R. at Jeannetts's Creek, Ont.

8418—October 14—Directing that the trains and cars of the G.T.R. Company be brought to a full stop before reaching crossing over the track of the Windsor & Tecumseh Electric Railway in Township of Sandwich East; and be flagged across; and that the cars of the Windsor & Tecumseh Electric Railway be operated across diamond at a rate of speed not exceeding four miles per hour, Township Sandwich East, Ont.

(Continued on page 517).

## PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

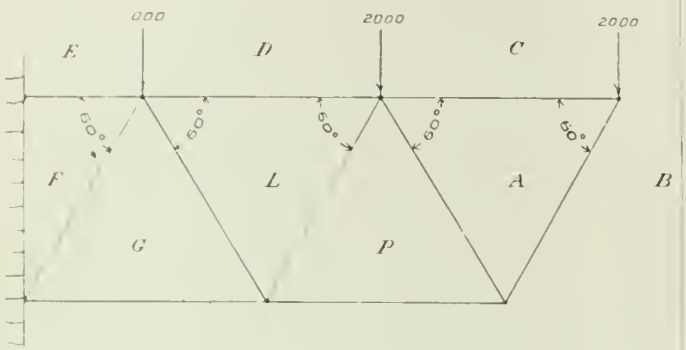



Fig. 67.

**Find the stress in the members of a cantilever such as indicated in Fig. 67, the panels of which are equilateral triangles.**

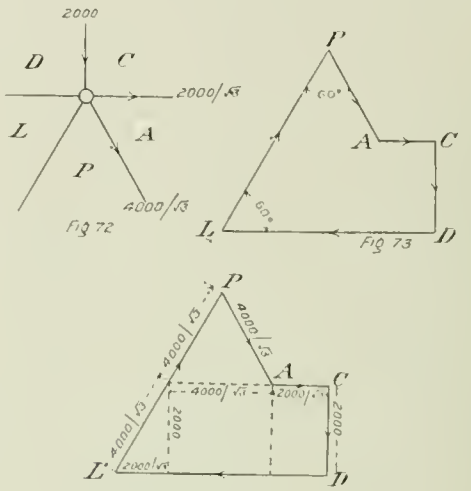
In all the following problems on the determination of the stress in the members of a framed structure, **the joints of the truss must be considered as frictionless circular pin joints, perfectly fitted so as to allow of no slack motion,** these being the assumptions upon which the theory is based. So, then, whenever the reader encounters the statement to consider the forces acting at a point in a truss, he must bear in mind that he is really considering **the forces which act on the pin of the joint,** for in any statical problem, when a set of forces are being considered, there must always be some body acted upon. In these cases the pin is that body, and the members are the bodies acting on it. It may be pointed out, however, **that because of this construction,** the lines of action of the forces acting on the pin intersect at the centre of the pin, and it is this fact that is referred to in the statement: "To consider the forces acting at a point." With the exception of the case of three forces in equilibrium, which, of course, **must** have directions intersecting at a common point, it must not be thought that the forces acting at a joint in a truss must act through the centre of the pin in order to be in equilibrium. **They merely do so,** as pointed out before, **because of the construction of the joint.**

Consider the point BCA. The forces acting at this point are in equilibrium, the conditions being such as indicated in the Statical Diagram (Fig. 68). If the Vector Polygon for this set of forces be constructed, it must close.

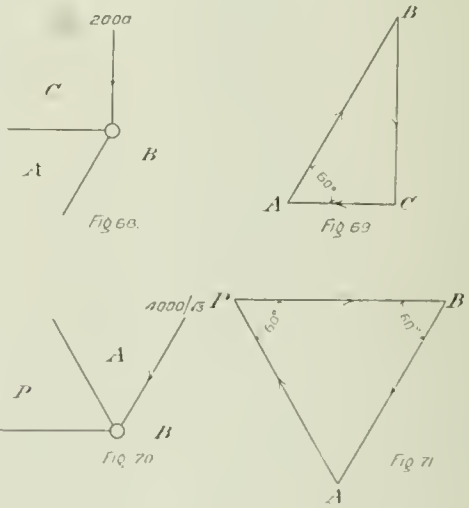
The reader must bear in mind the **important** fact that these Statical Diagrams merely represent the conditions **at the point being considered.** The lines indicating the directions of the known and unknown forces are **the lines of action of forces acting on the pin.**

In the following discussion it will be assumed that the relative lines of action of the forces being considered are accurately represented in the Statical Diagram; so that in constructing the Vector Polygon for a set of forces, all that will be necessary, in order to represent the direction of any force, will be to draw a line parallel to the line representing the force in the Statical Diagram.

Construct BC (Fig. 69) to represent the known vertical force. From C and B draw lines parallel to CA and AB (Fig. 68), respectively, to represent the directions of the unknown forces CA and AB. These lines intersect at A. Evidently CA and AB (Fig. 69) represent the unknown forces CA and AB, their magnitudes being $2{,}000/\sqrt{3}$ pounds and $4{,}000/\sqrt{3}$ pounds, respectively.




If the sense marks of CA and AB found in Fig. 69 be placed on the Statical Diagram (Fig. 68), it is seen that the member CA exerts, at the point being considered, a tensile force, and the member AB a compressive force. The member CA is, therefore, in tension,




and the member AB in compression, to the extent of $2{,}000/\sqrt{3}$ pounds and $4{,}000/\sqrt{3}$ pounds, respectively.

Consider the point BAP. Since the member BA is in compression, it must exert a compressive force at the point BAP. This, together with the other conditions at the point, is represented in the Statical Diagram (Fig. 70).

BA (Fig. 71) represents the known force BA. From A and B draw lines parallel to the directions of AP and PB (Fig. 70), respectively. These lines intersect at P. Then AP and PB (Fig. 71), with sense marks running

continuously as indicated, must represent the hitherto unknown forces AP and PB.

If the sense marks of AP and PB as found in Fig. 71 be placed on the corresponding lines of action of AP and PB in Fig. 70, it is seen that AP acts away from the point and PB against it. The member AP, therefore, exerts a tensile force and the member PB a compressive force at the point, both being forces of $4,000/\sqrt{3}$ pounds, since the triangle BAP (Fig. 71) is equilateral.

The member AP is, therefore, in tension $4,000/\sqrt{3}$ pounds, and the member PB in compression $4,000/\sqrt{3}$ pounds.

Consider the point PACDL. Acting at this point are three known forces (the load and two tensile forces exerted by the tension members PA and AC) and two unknown forces as indicated in the Statical Diagram (Fig. 72).

PA, AC, and CD (Fig. 73) represent the known forces PA, AC, and CD. From D and P, respectively, draw lines parallel to the directions of DL and LP (Fig. 72), intersecting at L. DL and LP (Fig. 73) represent, respectively, the unknown forces DL and LP, acting as indicated by the continuously pointed sense marks. In order to avoid confusion, another diagram (Fig. 74) has been constructed, showing how to arrive at the magnitudes of DL and LP. From this diagram it is seen that DL and LP are forces of $8,000/\sqrt{3}$ pounds each.

The force DL evidently acts away from the point (tensile force) and LP against the point (compressive force). The member DL is, therefore, in tension $8,000 \div \sqrt{3}$ pounds, and the member LP in compression $8,000 \div \sqrt{3}$ pounds.

**Find the stress in the remaining members LG, GB, EF, and FG.**

These stresses may be found by first considering the point BPLG, and then the point GLDEF.

(The correct diagrams for these points will be shown next week.)

## THE ROAD SURFACE.*

**By W. A. McLean, Engineer of Highways, Toronto.**

Country highways of Ontario are every year increasing in importance. Without good roads, efforts to improve homes and farms, and commercial and social conditions, throughout the Province, will be largely nullified. As feeders of, and distributors from, the railways, country roads are of great importance to towns and cities. Important as country roads were before the advent of the steam railway, the extension of steam railways has greatly increased their value, for steam railways mean development; and that development, if it means anything, implies the necessity of good country roads.

The road and the vehicle are part of one machine, just as the efficiency of the steam engine is dependent upon steel rails and the roadbed. With the coming of motor vehicles a new era in the use of roads is dawning, and to reap the benefit, country roads must be equal to their new counterpart—the horseless vehicle. Ontario roads are not yet in keeping with the horse-drawn vehicle. While it may seem impracticable to aim at serving a higher class of traffic, it can only be neglected to our own loss.

Problems of road construction involve a considerable degree of skill in dealing with drainage, grades and contours, sub-soils and earthwork, road metal, road location, bridges, road machinery, etc. In addition we have systems of road management and the supervision of labour.

Treating of one department—the road surface—it is impossible to ignore various other features. Mud underneath the road is more destructive than mud on the surface, so that without a well-drained and firm sub soil, the best road surface must prove a failure. The science of road construction is broad, and to discuss briefly a few details, it is necessary that we assume a suitable foundation, that the road is well located, that drainage is ample, and that the turnpiking is sufficient.

Road metal is placed on a road to make, so far as possible, a waterproof covering for the soil; to make a surface that will resist wear; to distribute the concentrated wheel load over a greater area of sub-soil, and to overcome the surface tendency to mud and dust.

The sub-soil should be crowned, and should be even, without depressions. This is particularly necessary in the case of clay. If there are depressions in a clay surface below the stone, water will find its way into them, will lie there, soften the soil, and weak spots will develop in the road surface through a condition of mud below it.

Before putting stone on an earth roadbed, the sub-soil should be solidified with a roller. This is too commonly evaded in an effort to keep down the cost. It is necessary that the metal form a distinct crust, if its full degree of usefulness is to be obtained. Stone forced down into a soft sub-soil is largely wasted. However firmly a surface layer of road metal may itself be rolled, it will display weakness if the sub-soil has not been consolidated. Earth in its natural state, however solid it may appear, is not as compact as rolling can make it. The cost of roads is not so much in the earthwork as in the cost of treating and hauling surface material. In the amount of metal saved from sinking into a loose sub-soil, and in the greater strength of the road, the cost of rolling the sub-soil is more than repaid.

The road metal, gravel or stone, is intended to form a separate crust over the natural soil, and should be so treated by rolling that it will be a distinct and firmly compacted covering. The benefits of rolling are numerous and difficult to sum up briefly. Rolling is an absolute necessity for the most economical, as well as most durable and satisfactory type of road. Without rolling, a large proportion of the road metal is forced into the sub-soil and wasted before it is bonded into a distinct crust. The road cannot be well formed when it is left for traffic to consolidate. The citizens who are compelled to drive through a mound of loose road metal will never give praise to the man who constructs such a road. By building a finished road on which it is a delight to drive, a little extra cost is quickly forgotten. A more durable road is obtained and the additional expense is further offset by the considerable saving of road metal.

A road surface may be constructed in various ways. The road may be surfaced wholly with crushed stone, using "crusher run"; that is, a mixture of fine and coarse, just as it comes from the crusher, without screening. This makes a surface of uneven quality and strength, and hollows and holes appear quickly under heavy traffic.

Screened stone may be used, placing the coarsest in the bottom and the finer on top. This makes a much smoother surface, of more uniform strength, than does "crusher run." It pays to screen.

Instead of making the road wholly of crushed stone, large flat stones, of sizes up to a foot or eighteen inches square may be laid on the earth sub-grade, and crushed stone spread over this. This, as a rule, is cheaper than all crushed

* Read before the Ontario Land Surveyors.

stone, as a thinner covering of fine (and more expensive) material is required. Where flake stones are used in this way, perfect under-drainage is desirable; otherwise the larger material is heaved by frost, and the finer metal gradually works downward, the large stones coming to the surface. Instead of laying the stone flat, they may be placed on edge, the largest at the centre of the road, the top angles being chipped off and wedged into the voids between the stone. This last method is known as a "Telford" foundation, and is to be recommended for weak sub-soils, or where drainage is difficult.

Instead of a base of large stone, there may be spread a foundation layer of gravel, on which to spread the broken stone. This method is useful where gravel of an inferior quality is plentiful. The gravel makes a stronger foundation than does the natural earth, while the crushed stone makes a more durable wearing surface.

Good results may be had in some cases by using large flake stone for a base and placing gravel on top. This process is useful principally where the earth foundation is very weak, and a gravel of first-class quality can be obtained within reasonable haul.

A common method consists of using pit-gravel in the ordinary manner, without stone. Unless of very exceptional quality, gravel roads are not so lasting as broken stone, particularly for heavy or constant traffic—but it is a question of traffic as well as metal. As a rule, broken stone should be used near large towns. This provides for heavy traffic, with a short wagon-haul if the stone has to be brought in by rail.

A profitable method of using gravel is to pass it through a crusher and screen out the excess of sand and earthy material. Use the screenings as a base, and place the stone on top for a wearing surface. By using a well-equipped plant, and loading wagons from a bin, the saving in cost of loading may be made to pay the cost of crushing and screening, particularly for short hauls from the pit.

In the choice of stone there is room for much variation in the quality of the road. After gravel, the most commonly used material in Ontario is limestone. In this there is much difference in quality, even in the same quarry. Limestone while softer than most other rocks, gets it value largely by the power of its dust and screenings to cement and re-cement, making an exceptionally waterproof covering, and so bonding as to distribute the concentrated wheel load. The most durable class of road metal is trap rock, but unfortunately there is little available. Granite and gneiss are used with considerable success. Sandstone is very inferior, as it grinds readily into dust, and has little cementing value. Granite and gneiss have not good cementing value, but are harder and more resistant to wear.

The strength and durability of a road is dependent largely upon the binding material used, as developed by thorough sprinkling, and the use of a steam roller. When rolling a road the roller should be preceded by a sprinkler, and the stone kept well saturated. Limestone screenings are most valuable as a binding material, but some limestones have a much stronger cementing value than others. Crystalline limestones are in some cases of little more value in this respect than sandstones. Sand is a very inferior binder. Road metal should be clean, for clay and loam are weak binders. Crushed gravel, bonded with limestone screenings, makes a surface much superior to gravel only.

The width of roads is an important detail in surface treatment. Throughout Ontario all varieties of ideas prevail in this regard. We find the roads graded almost from fence to fence, the full width of the road allowance. In other cases the opposite degree is sought. From study of road conditions in Ontario I am convinced that the width of a road from ditch to ditch should be no greater than traffic demands. The width of road metal should be such that there will not be an earth track at the side. Wide grades are very desirable when kept in good repair, nor are they much more expensive to construct than narrow roads. But they are vastly more difficult and expensive to keep in repair. The choice, except under special conditions, will be between a narrow road that is good and a wide road that is bad. Few municipalities in Ontario, or indeed in any part of the world, will be found so wealthy that they can afford to maintain an unnecessary width of road. When a strip of macadam is flanked by wide, flat clay shoulders, the early destruction of the macadam is certain. Standard European practice is 18 or 20 feet between gutters, and while many roads are wider, others are narrower. This is a point of economy which, for the sake of good roads at least, municipalities in Ontario could well copy. As traffic increases, widen the metal rather than the grade.

The camber or crown of a road gives much play for difference of opinion. A high crown is not desirable so far as traffic is concerned. A new road, however, should first be turnpiked and crowned too high, otherwise it will soon get too flat. A road just right when first constructed will be water-logged at the end of a couple of years. All forces of gravity and traffic are at work to bear down on the camber and grade, the flattening tendency is constant. Under ordinary circumstances in Ontario a crown of one inch to the foot for the stone covering, and two inches to the foot for earth shoulders, is not too great. In the case of town streets, if constant attention is given to repair and the roads are macadamized from curb to curb, this can be reduced; but in the country, narrow roads, sharply crowned, are the roads which return most for the expenditure on them.

The coming of the automobile has drawn attention to the exceedingly dusty condition of roads in summer. The extended use of these machines requires that there be some palliative, both for the property owners along the roads and for the maintenance of the roads themselves. While light motor vehicles travelling at a moderate speed will not seriously injure the roads, the dust removed by heavy touring cars travelling at a high speed removes the binding material, and the stone unravels. A large amount of experiment has been carried on with a view to finding a remedy. Many materials, patented and otherwise, have been brought to public notice. Their careers are usually ephemeral. Tar and tar products are the only materials that have been used with marked success in England, France or the United States. A thoroughly servicable and cheap system has not been developed. The majority of methods are either too expensive for the ordinary use in Ontario, or they are unsuited to our conditions of climate.

This is one of the fields in which there is room for invention in road construction. At the International Road Convention in Paris during October of last year, all departments of road construction received careful and scientific attention. In the conclusions of that convention, however, it has not been shown that any marked advance has in recent years been made in methods of construction. The field is still an open one, and there is much to be hoped for in achieving a type of construction that is at once serviceable, durable and economical.

QUEBEC.—Survey parties have been organized by Mr. A. R. Decary, district engineer of the Department of Public Works, in connection with the preparation of a report on the possibilities of improving the harbour facilities at Quebec.

## RAILWAY ORDERS.

(Continued from page 513).

8419—October 13—Directing that the C.P.R. and C.N.O.R. construct at their own expense, the portion of highway within their limits of their respective right of way on Lot 6, Township of Foley, Ont.

8420—October 19—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for Hill Manufacturing Company in Block 11, Plan F. V., in city of Saskatoon, Sask.

8421—October 19—Approving proposed new bridge across Preston Street in the city of Ottawa, Ont., to be erected by the G.T.R.

8422—October 12—Requiring the G.T.R. to install at the crossing of Park and Duke Streets, Chatham, Ont., within 45 days from date of Order, an electric bell to be located and bonded to the satisfaction of the Chief Engineer of the Board.

8423—October 20—Granting leave to the C.N.Q.R. to construct its line and tracks, by means of a subway, across public road on Lot 27, Parish of St. Stanislas, County Champlain, P.Q

8424—October 15—Amending Order of Board No. 5681, dated November 12th, 1908; directing that the G.T.R. erect and maintain gates and watchmen at Windermere and Ellis Avenues, Township York, Ont., by directing that the two-twelfths directed under the said Order to be paid by the County of York, be distributed equally between the city of Toronto, Township of York, and the G.T.R. Company.

8425—October 13—Directing that the Hamilton Radial Railway construct a suitable farm crossing in the Township of Nelson, County of Halton, Ontario.

8426—October 14—Amending Order of the Board No. 6677, dated March 26th, 1909, made upon the application of the corporation of the Township of Tilbury East, approving the plans and specifications of the "King and Whittle Drain," in the Township of Tilbury East, in so far as they affect the property of C.P.R. by striking out the whole of the last five lines of the said Order after the word "approved" in the third line thereof.

8427—October 19—Granting leave to the Manitoba Government Telephone to erect place, and maintain its wires across the track of the C.P.R. near Teulon Station, Manitoba.

8428—October 19—Ordering that the M.C.R.R. widen the bed of the stream across its right of way under the bridge at Bear Creek, one mile east of the town of Petrolea, Ont.

8429—October 22—Authorizing the Ontario and West Shore Railway Company, at its own expense, to make a temporary connection of its tracks with the tracks of the Guelph and Goderich Railway at Menesetung Station, Ont.

8430 and 8431—October 22—Granting leave to the Saskatchewan Government Telephones to erect, place, and maintain its wires across the track of the C.N.R., N.W. ¼ of Sec. 10, Tp. 37, R. 5, west 3rd Meridian and near Warman, Sask.

8432 and 8433—October 22—Approving and sanctioning location of the C.N.O. Railway through County Leeds, Ont., and through Townships 44-50, Ranges 16-20, west 3rd Meridian, Province Saskatchewan.

8434—October 22—Granting leave to the C.P.R. to construct an extra track of its railway across Osler Street, Cayley, Alta.

8435—October 22—Granting leave to the C.P.R. to construct, maintain, and operate industrial spur for Mr. Phillips Saumure, town of St. Louis, Parish of Montreal, P.Q.

8436—October 20—Authorizing the C. N. Railway to cross the lines and tracks of the C.P.R. Company's Arcola branch, at Carlyle, Sask.

8437—October 22—Authorizing the Atlantic, Quebec and Western Railway to construct twelve pine trestles on Sections 5 to 10 of its line of railway.

8438—October 21—Authorizing the G.T.R. to reconstruct overhead bridge which carries the highway over its tracks between lots 16 and 17 in 8th concession, Township of Grantham, between St. Catharines and Merritton, Ont.

8439—October 14—Ordering that C.P.R. extend its platform at Creelman, Sask., to a length of 240 feet on or before 1st of May, 1910.

8440—October 14—Dismissing application of the residents of Keeler, Sask., for Order that the C.P.R. erect a suitable freight and passenger station and appoint a permanent agent at Keeler, Sask.

8441—October 15—Dismissing application of the city of Saskatoon, Sask., for an Order that the C.N.R. widen the approaches of 11th Street in said city.

8442—October 15—Dismissing petition of the residents of the district near Saskatoon, for an Order directing the C.N.R. to construct siding on N.E. ¼ of Sec. 26, Tp. 35, R. 7, Sask.

8443—October 15—Dismissing complaint of the Board of Trade of Battleford, Sask., that the C.N.R. has not made proper provision for the loading and shipping of traffic.

8444—October 13—Ordering that the C.N.R. construct, prior to the first of December, 1909, crossing where its railway across the highway between Sections 28 and 29, Tp. 13, R. 14, Manitoba.

8445—October 13—Ordering the C.N.R. to convey to the Municipality of Strathclair, Man., prior to December 1st, 1909, strip of land for a highway in lieu of land taken by the railway company.

8446—October 13—Dismissing application of the municipality of Miniota, Man., for Order that the C.P.R. construct a transfer track of the G.T.P. Railway at Quadra Siding, Man.

8447—October 13—Ordering the C.N.R. to construct, before the 1st of December, 1909, where its railway crosses five highways in the municipality of McCreary, Man.

8448—October 13—Dismissing complaint of R. A. Knight, of Hargrave, Man., alleging discrimination in freight rates of the C.P.R. from Lethbridge to C.N.R. points.

8449—October 13—Dismissing complaint of B. Maxfield, of Souris, Man., alleging dangerous condition of highway crossing over the C.P.R. at First Street, Souris, Man.

8450—October 13—Ordering the C.N.R. to construct, before December 1st, 1909, highway crossings where its railway crosses the highway between Sections 24 and 25, Tp. 13, R. 15, in municipality of Langford, Man.

8451—October 14—Ordering the municipality of Midale to open a highway, from Railway Avenue in north-east direction, across tracks of the C.P.R. at Midale, Sask.

8452—October 14—Authorizing the village of Brownlee, Sask., to construct a highway across the tracks and property of the C.P.R.

8453—October 14—Ordering the C.P.R. to construct, maintain, and operate for a period of three years branch line to Parliament Buildings, Regina, Sask.

8454—October 18—Directing that the C.N.R. establish a flag station and suitable loading platform at Fenton, Sask.

8455—October 18—Dismissing complaint of the Board of Trade, Prince Albert, Sask., alleging unsatisfactory train connection between the C.P.R. and C.N.R. at Regina, Sask.

8456—October 18—Dismissing complaint of Board of Trade of Prince Albert alleging defective and unsafe condition of roadbed of Prince Albert section of north line of C.N.R.

(Continued on Page 523.)

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Oct. 31 | | STOCK QUOTATIONS TORONTO | | | | MONTREAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Oct. 28 '08 | Price Oct. 21 '09 | Price Oct. 28 '09 | Sales Week End'd Oct.28 | Price Oct. 28 08 | Price Oct. 21 09 | Price Oct. 28 '09 | Sale Week End'd Oct.28 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $3,224,000 | 2.446.000 | 175 174 | 183¼ | 184¼ 183¾ | 541 | 175 174 | 183½ | 183¾ 183½ | 1010 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 457 300 | 385,200 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | ..... | ..... | ..... | ..... | *1st. pref. 108¼, 3rd pref. 57½, ordinary 23¾ | ..... | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 74,463 | 68.954 | ..... | ..... | ..... | ..... | 192 | 191¾ | 211½ 210½ | 207½ 202 | 1181 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,218 | 69,724 | ..... | 124 | 123 122¾ | 180 | 104⅝ | 103½ | 125 123½ | 123½ 122⅜ | 1026 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 168 | 185 | 183 | ..... | | 167 | ..... | ..... | ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILWAY ACCIDENTS FOR OCTOBER.

### Thirty-Nine Killed and Forty Injured.

| Character of Accident | Passengers K. | Passengers I. | Employees K. | Employees I. | Others K. | Others I. | Total K. | Total I. |
|---|---|---|---|---|---|---|---|---|
| Derailment | .. | 4 | 2 | 15 | .. | .. | 2 | 19 |
| Head-on Collision | .. | .. | 7 | 3 | .. | .. | 7 | 3 |
| While shunting | .. | .. | 4 | 3 | .. | .. | 4 | 3 |
| Highway crossing | .. | .. | .. | .. | 3 | 2 | 3 | 2 |
| Trespassing | .. | .. | .. | .. | 8 | 4 | 8 | 4 |
| Fell off freight cars | .. | .. | 3 | 1 | .. | .. | 3 | 1 |
| Pitch-in with hand car | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Adjusting couplings | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Passengers falling off | 2 | .. | .. | .. | .. | .. | 2 | .. |
| Working on track | .. | .. | 2 | 1 | .. | .. | 2 | 1 |
| Attempt to board moving train | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Unclassified | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Working on cars | .. | .. | 2 | .. | .. | .. | 2 | .. |
| Collision (rear-end) | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Jumping off moving train | 1 | .. | .. | 3 | .. | .. | 1 | 3 |
| Struck by water tank | .. | .. | 1 | .. | .. | .. | 1 | .. |
| Working on cars and engines | .. | .. | .. | 2 | .. | .. | .. | 2 |
| Couplings broke | .. | .. | .. | 1 | .. | .. | .. | 1 |
| Totals | 3 | 4 | 25 | 30 | 11 | 6 | 39 | 40 |

From the above table it will be observed that men engaged in actual operation of trains figured largely among the victims of the accidents which occurred on the steam railways of Canada during October. Derailments and collisions were responsible for the majority of fatalities relating to employees, while twelve of the accidents, eight proving fatal, were due to trespassing. During the month, thirty-nine persons were killed and forty were injured. Figures relating to the past three months are appended:

| 1909 | Passengers K. | Passengers I. | Employees K. | Employees I. | Others K. | Others I. | Total K. | Total I. |
|---|---|---|---|---|---|---|---|---|
| October | 3 | 4 | 25 | 30 | 11 | 6 | 39 | 40 |
| September | 0 | 5 | 18 | 15 | 15 | 7 | 33 | 27 |
| August | 4 | 5 | 6 | 8 | 22 | 2 | 32 | 15 |

### In the United States.

In this connection some figures regarding the accidents on railways in the United States will be interesting. A report, just issued by the Interstate Commerce Commission, for the year ended June 30, 1909, shows a decrease in the number of casualties. During the year 2,791 persons were killed and 63,920 were injured, as against 3,764 killed and 68,869 injured during the previous year. The total number of collisions and derailments during the second quarter of 1909 was 2,100, and the damage to cars, engines and roadways was $1,703,642.

### In Great Britain.

It is interesting to note that not a single passenger was killed last year in a train accident in Great Britain. So far as these records go back, there has only been one other year (1901) when this was the case. The average for the past ten years is twenty-one passengers killed and 626 injured. Last year only 283 passengers were injured. Six railway servants were killed, however, and 164 injured in train accidents, and a number were killed and injured in performing their work. The fact that no passengers were killed and that so few were injured shows how safe railway travelling has become

### On the Electric Roads.

A slight improvement will be noticed in the October returns of accidents on the electric railways, the record for September being especially unenviable. Here are the figures:

| October 1909 | Killed. | Injured. |
|---|---|---|
| Run over | 1 | 1 |
| Fell off | .. | 1 |
| Struck | 1 | 10 |
| Derailment | .. | 1 |
| Alighting | .. | 1 |
| Collisions | .. | 14 |
| October 1909 totals | 2 | 28 |
| September 1909 " | 7 | 32 |
| August 1909 " | 3 | 27 |

### Notes of Wrecks.

At London, Ont., a freight train conductor's lamp was extinguished and he was unable to stop a fast eastbound Sarnia freight which collided with his train, wrecking the engine and many cars.

Traffic was delayed twelve hours by washouts on the I.C.R.

Part of a C.N.R. freight train was derailed at Pratt, near Brandon, Man., causing some delay to other trains and wrecking several cars.

A defective rail caused a freight train wreck near Port Hope, Ont. Nine loaded cars in addition to the engine were derailed.

Accidents causing neither loss of life nor injury but resulting in more or less damage to rolling stock and the right-of-way occurred in the neighbourhood of the following stations: Vancouver, B.C.; Orangeville, Ont.; Port Hope, Ont.; North Bay, Ont.; Ellershouse, N.S.; Fernie, B.C.; London, Ont.; Coatsworth, Ont.; White River, Ont.; Saskatoon, Sask.; Halifax, N.S.; Ramsay, Ont.; Grand Falls, N.B.; Edwards, Ont.; Cartier, Ont., and Brandon, Man.

## I. C. R. EARNINGS.

For the first six months of the fiscal year an increase of $100,000 is reported in the gross earnings of the Intercolonial Railway.

## CAPE BRETON ELECTRIC RAILWAY

### Gross Earnings.

| | | |
|---|---|---|
| Gross earnings August, | 1909 | $ 22,005 |
| " " " | 1908 | 22,958 |
| Operating expenses, August, | 1908 | 11,504 |
| " " " | 1908 | 11,886 |
| Gross earnings for 8 months, | 1909 | 148,388 |
| " " " | 1908 | 159,817 |

## GUELPH RADIAL RAILWAY

The annual report of the Guelph Radial Railway Board as presented to the City Council on November 1st, shows a net profit for the year of $6,523.35. The sum of $6,000 was laid aside for maintenance of plant. Before the city took over the road, under private ownership it was a losing proposition.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

ARTHABASKA.—The secretary-treasurer of the council of the County of Arthabaska will receive up to Thursday, December 9th, tenders for the construction of a steel bridge on the Becancour River, between the municipalities of St. Louis of Blandford and the township of Stanfold. Louis Lavergne, secretary-treasurer.

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

MONTREAL.—Bids will be received up to Wednesday, 10th November, for about 100,000 feet B.M. Sawn Hemlock Lumber, and about 75,000 feet B.M. Sawn Pine Lumber, all one inch thick. Permits to inspect the lumber may be obtained upon application to Mr. F. W. Cowie, Chief Engineer. David Seath, Secretary, Montreal Harbor Commission, 57 Common Street.

MONTREAL.—Tenders will be received until Monday, the 15th November, for the construction of a 5-foot circular sewer in the under-mentioned section of street, with the necessary connections according to the sections and specifications on view in my office, viz.:—Sherbrooke Street, 5th Section—From Victoria Street to Drummond Street. John R. Barlow, City Surveyor.

QUEBEC.—Tenders will be received until Tuesday, the 30th November, for the building of the substructure of the Quebec Bridge. The general specification and form of tender will be ready about November 20th; but in the meantime contractors are invited to visit the office of the Quebec Bridge Board of Engineers, Canadian Express Building, Montreal, for the purpose of securing preliminary information to enable them to submit tenders for this work. L. K. Jones, secretary, Department of Railways, and Canals, Ottawa.

QUEBEC.—Tenders will be received until Monday, the 15th November, for the removal of the wreckage of the Quebec Bridge on the Anchor Arm, and on that portion of the Cantilever Arm, down to low water. Full information can be obtained at the Department of Railways and Canals, Ottawa. Parties tendering are to quote a price for the purchase of the material as it stands, which they may remove and dispose of as they wish. L. K. Jones, secretary, Department of Railways and Canals, Ottawa.

**Ontario.**

BURLEIGH FALLS.—Tenders will be received up to Tuesday, 16th November, for the works connected with the construction of a concrete dam at Burleigh Falls, on the Trent Canal. L. K. Jones, secretary, Department of Railways and Canals, Ottawa.

BERLIN.—The time for receiving tenders for King Street pavement is extended to Thursday, November 11th. Tenders received on October 28th will be returned unopened. Amended specification and plan may be obtained from Mr. W. M. Davis, town engineer, on application. A. H. Millar, town clerk.

DUNNVILLE.—Tenders will be received until Thursday, November 18th, for constructing a system of sanitary sewers comprising about 18,000 lineal feet of tile sewers. the contractor to furnish all materials therefore. The entire work is to be completed on or before August 31st, 1910. Robert Bennett, Mayor; J. W. Holmes, town clerk; Willis Chipman, chief engineer, 103 Bay Street, Toronto.

LONDON.—Tenders will be received until Wednesday, November 10th, for underground conduit and cable system for electric light and power supply. Tenders are also invited until November 22nd on the transformers, motor generator set, voltage regulators, switchboards, lightning protectors, instruments, arc and incandescent street lighting systems, and other electrical apparatus. Address, Mr. E. I. Sifton, Electrical Engineer, City Hall.

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received until Monday, November 22, for additions and alterations to the Toronto General Post Office. Plans may be seen at the office of Mr. Thomas Hastings, clerk of works, Customs Buildings, Toronto; N. Tessier, secretary, Department of Public Works, Ottawa. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Wednesday, 10th November, for all the cherry, birch, maple, spruce, hemlock and other classes of timber, estimated to contain over fifty million feet of hardwood, and over fifty million feet of soft wood, on a tract situated on the Georgian Bay at Beaverstone River. McCarthy, Osler, Hoskins & Harcourt, Toronto, Solicitors.

## CONTRACTS AWARDED

**New Brunswick.**

ST. JOHN.—The city of St. John recently invited tenders for the excavation, backfill and carriage for a main sewer to be laid in Harding street. Mr. Peter Arsenault received the contract at: Earth, 80 cents; rock, $2.75 per lineal foot. Average depth, 7¾ feet. The pipe will be provided and laid by the city. Mr. Wm. Murdock, City Engineer.

**Quebec**

QUEBEC.—The Levis Ferry Company have awarded to Messrs. Davie a contract for the construction of the pontoons required for the ferry service between Quebec and Levis.

**Ontario.**

TORONTO.—Sixteen tenders were received for the electrical pumps to be used in connection with the city's waterworks system. The contract for the machinery, which will probably cost about $150,000, has not yet been awarded.

TORONTO.—The Board of Control recently awarded contracts, as follows:—Canada Foundry Company, check valves, $148.54; Matthew Warnock, 16-inch stop valves, $1,496; Jenks-Dresser Company, Sarnia, Ont., steel gates and railing for Broadview Avenue lavatory; excavation, drainage, masonry, William Forbes & Sons, $5,590; joiner work, painting and glazing, William Forbes & Sons, $540; plumbing, heating and ventilation, John Ritchie Co., $3,700.

The day following the awarding of contract for the steel work, local contractors complained that they were not aware that tenders had been invited and the controllers decided to cancel the contract and advertise again.

TORONTO.—The Board of Control have authorized City Engineer Rust to transfer his contract at $14,168 for the asphalt pavement on Shaw Street, from College to Bloor, to the Constructing and Paving Company, and his contract at $6,507 for a bitulithic pavement on Russell Hill road, from Clarendon to St. Clair, to the Warren Bituminous Pav-

ing Co. John F. Connolly was granted a contract to put in a sewer on Lonsdale avenue at a cost of $482. The next tenderer's figure was $483, and the city engineer's figure was $538.

BRANTFORD.—The board of works have recommended that the tender of the Westrumite Company for the brick pavement on Brant Avenue, between Church Street and St. Paul's Avenue at $2.29 per square yard be accepted.

BRANTFORD.—The contract for installing the heating and plumbing systems in the new Collegiate Institute have been awarded to Howie & Feely. The cost is in the neighborhood of $13,000.

WESTON.—Contracts for the new plant, in connection with the waterworks scheme, were awarded as follows:—Contract "A," labor in laying out pipes and furnishing certain materials, J. F. Connolly, Toronto. Contract "C 1," steel water tower, Toronto Iron Works, $5,040. Contract "C 2," concrete foundation for water tower, G. B. Moork, Berlin, $1,350. Contract "D," all cast iron water pipes and special castings, Canada Foundry Co. Contract "E," fire hydrants, sprinkling cranes, gate valves and valve boxes, The London Foundry Co. The approximate cost of the work is $55,000.

**Manitoba.**

WINNIPEG.—The tender of McDougall & Orton for 300 cords of green cut dry tamarac at $5.20 per cord was accepted by the Board of Control who considered the tender as particularly satisfactory, it being stated that the retail price of tamarac to consumers was $6.50 per cord.

## RAILWAYS STEAM AND ELECTRIC

**Ontario.**

WELLAND.—The N. St. C. & T. Railway is understood to be planning extensions from Fort Erie to Port Colborne.

TORONTO.—The contract for the building of the spur line on the T. & N. O. Railway, connecting with the main line at New Liskeard and continuing about a mile to serve several mining industries, has been awarded by the Commissioners to the Canadian Contracts, Ltd., the new Toronto firm. The work will be proceeded with at once.

**Manitoba**

WINNIPEG.—Only fifteen miles of track on the C.N.R. remain to be laid with heavy steel between here and Port Arthur, and as soon as this work is completed running time between the two terminals will be greatly reduced.

**Saskatchewan.**

GRENFELL.—The Grand Trunk Pacific survey parties are now engaged on the final survey of the section between Qu'Appelle and Regina, of the Yorkton branch of that railway.

**British Columbia**

CHILLIWACK.—A survey party running a line for the Canadian Northern Railway recently entered the extreme east end of the Chilliwack Valley at Popcum, coming down from Hope, and are now working in the vicinity. Indications are that they will run a direct line across the eastern side of the valley to Vedder crossing, and from there parallel the British Columbia Electric Railway to Abbotsford.

VANCOUVER.—Contractors are commencing operations on the second 140-mile contract on the G.T.P. from Kitsilas Canyon to Aldermere, says Mr. G. A. McNicholl, purchasing agent for the G.T.P., who returned from Prince Rupert a few days ago, and he expects to call for tenders for half a million ties for this section shortly.

VANCOUVER.—Under the terms of the agreement between the Provincial Government and the Kettle Valley Railway, providing for the payment of a subsidy of $5,000 per mile for 150 miles, construction work will be started next spring at four different points. The line will link the boundary district with the Fraser Valley as well as tap the Okanagan and Similkameen districts. When completed, it will reduce the time between Vancouver and Penticton to eight hours, Midway twelve hours, Grand Forks thirteen hours and Nelson eighteen hours. The system will have a total mileage of 350. The maximum gradient will be one and one-half per cent in crossing the summit between West Fork and the Okanagan Valley. For the remainder of the distance to Nicola the grade will be less than one-half of one per cent.

## SEWERAGE AND WATERWORKS.

**Ontario.**

BOWMANVILLE.—Mr. T. Aird Murray, consulting sanitary engineer, of Toronto, has been engaged by the town of Bowmanville to prepare plans for a water supply.

NORTH BAY.—The Nipissing Power Company offers to pump the water for the town on a ten-year contract, at two cents per 1,000 gallons, or two cents for stated amount, and 1¾ cents for additional 1,000. This will be considered by a committee of whole council at a secial meeting.

**Ontario.**

COLDWATER.—The plebiscite vote on waterworks resulted as follows: For complete waterworks, 53; for fire protection only, 10; against both, 2.

**British Columbia.**

PRINCE RUPERT.—Work at the waterworks intake has been progressing rapidly. A temporary intake has been arranged and the 10-inch main was connected a few days ago with the G.T.P. 10-inch main at the foot of the mountain. There was not a leak in the line when the water was turned on. The new dam is built of heavy cribwork across a pocket in the mountain stream. It will bave a face of timber set in concrete. An automatic valve will regulate the supply of water and allow none to run to waste during the season of low water.

## LIGHT, HEAT, AND POWER.

**Ontario.**

OTTAWA.—American and Canadian capitalists interested in the development of the water power of the Long Sault Rapids on the St. Lawrence River, near Cornwall, have submitted to the Government, revised plans which eliminate the objection on the ground that navigation would be interfered with.

TORONTO.—Mr. Justice Riddell on Monday morning dismissed the action of the Ontario Government against the Canadian & Niagara Power Company for $15,217, as representing power in excess of the 10,000 horse-power according to the company's charter as the minimum above which anything would be charged. The Government wished to charge any higher reading till the end of the year or until it was exceeded, but His Lordship held that the company was liable only for the power actually developed, as indicated by the average daily reading.

## CEMENT—CONCRETE.

**Ontario.**

TORONTO.—A handsome trussed concrete bridge, across the Etobicoke River, connecting the Counties of York and Peel, and designed by Mr. Frank Barber, York County Engineer, and Mr. C. R. Young, B.A.Sc., was formally opened and tested on Tuesday, October 26th. The structure has a span of eighty feet and cost less than four thousand dollars. Mr. O. L. Hicks, of Humber Bay, was the contractor.

GUELPH.—Contractor Conery is getting along well with the new cement bridge at Presant's mill. The three cement arches are all but completed, and with good weather the entire structure will be finished within a week.

## FINANCING PUBLIC WORKS.

**Quebec**

MONTREAL.—Tenders for a loan of $800,000 will shortly be invited by the Ville St. Louis Council.

**Ontario**

EXETER.—The village of Exeter in Huron County, offers $22,000 debentures, issued for waterworks purposes. J. Senior, clerk.

ORILLIA.—Tenders will be received up to Monday, November 15th, for the following issue of debentures:—$55,000 sewerage, $15,000 cement walks, $20,000 public school, $3,000 park purposes, $50,000 loan to Tudhope Company. C. E. Grant, Treasurer.

**Alberta**

CALGARY.—The by-law to provide funds for extensions to the street railway was carried last Wednesday by a majority of 4.

## RAILWAY ORDERS.

(Continued from Page 517.)

8457—October 15—Directing the C.N.R. to remove its fences on the west side of its station yard at Bladmore, Sask., prior to December 1st, 1909.

8458—October 20—Directing the G.T.P. Railway to erect fences at each side of its right of way through the district of East Clover Bar, Alta.

8459—October 20—Directing the G.T.P. Railway to erect fences at each side of its right of way in the district of Clover Bar, Alta.

8460—October 20—Dismissing application of the residents of Round Hill, District Alberta, for Order requiring the C.N.R. Company to locate a station at Round Hill, Alta.

8461—October 20—Dismissing complaint of the Clover Bar Coal Company, Limited, of Edmonton, Alta., alleging discrimination of C.N.R. under tariff C.R.C. 304, effective May 25th, 1909.

8462—October 20—Directing that the G.T.P. Railway construct prior to first day of July, 1910, a subway with an opening 66 feet wide and 14 feet high, over the passage of Fort Saskatchewan trail, Edmonton, Alta.

8463—October 22—Authorizing the G.T.R. to construct, maintain, and operate branch line to and into the premises of the Golden Lake Lumber Company, Township of South Algoma, County Renfrew, Ont.

8464—October 22—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for Jas. McCreary, in Lot 12, Concession 1, Township of Hess, District of Algoma, Ont.

8465—October 22—Authorizing G. A. Farrill, of Kenilworth, Ont., to lay and thereafter maintain water pipe under the track of the C.P.R. at Kenilworth, Ont.

8466—October 22—Authorizing the corporation of the town of Drummondville, P.Q., to lay and thereafter maintain drain pipes under track of the C.P.R. at Convent St., in said town.

8467 and 8468—October 22—Granting leave to the Saskatchewan Government to erect, place and maintain its wires across the track of the C.N.R. west of Warman, Sask., and between Sections 2 and 3, Township 38, R. 5, west 3rd, Sask.

8469—October 22—Granting leave to the Bell Telephone Company to erect, place, and maintain its underground wires across the tracks of the N. St. C. & Toronto Railway at public crossing corner Court Street and Welland Avenue, St. Catharines, Ont.

8470—October 27.—Authorizing the G.T.R. to reconstruct bridge at mileage 29.62, on 16th Dist. between Rifle Range and Long Branch, on Toronto-Hamilton line.

8471—October 22—Authorizing the Hartland Village Water and Fire Commissioners to lay and thereafter maintain pipe under track of the C.P.R. at Bradley Street, Hartland, N.B.

8472 and 8473—October 27—Granting leave to the Volcanic Oil and Gas Company to place, erect, and maintain its wires across the track of the P.M.R.R. at Tecumseh Road, Township Sandwich East, Ont., and at town-line between Township Sandwich East and Sandwich South, County Essex, Ont.

8474 and 8475—October 27—Granting leave to the Government of the Province of Alberta to erect, place and maintain its wires across the track of the C.P.R., Sedgewick, Alta., and Aix, Alta.

## SOCIETY NOTES.

**Engineering Society, University of Toronto.**—On Wednesday afternoon, Mr. T. Kennard Thomson, C.E. (Tor. Univ.), consulting engineer, of New York, addressed the Engineering Society of Toronto University on "Foundations for High Buildings." In the evening, the S.P.S. Alumni held their first dinner of the season, at the St. Charles Hotel. Among the guests of the evening were President Falconer, Dean Galbraith and Mr. T. Kennard Thomson. Mr. C. M. Caniff, as "E. C. Easy," gave his humorous address

**McGill Science Undergraduates' Society.**—The postponed meeting of the McGill Science Undergraduates' Society was held in the large theatre of the Chemistry Building. The speaker of the evening was Mr. H. H. Vaughan, assistant to the vice-president of the C.P.R., who delivered an address on machine designing. These meetings are always well attended by the Science men, and an interesting programme enlivened by songs and music, followed by refreshments is always prepared. The officers of the society for 1909-10 were elected recently as follows: President, O. N. Brown, '10; vice-president, J. N. Timberlake, '10; secretary, P. H. Skelton, '11; treasurer, G. H. Walker, '11; reporter to Martlet, A. W. Clark, '10.

**Railway Engineman's Educational Club.**—With a view to increasing their technical knowledge there has been organized in Winnipeg what is known as the Railway Engineman's Educational Club. It has a membership of 250 and a branch at Kenora numbering 50 members. The employees of all railroads are eligible. The headquarters of the organization are in the Empress Block, Winnipeg. The president is C. A. Boyd; vice-president, J. McLachlan; secretary, G. F. Collins, and treasurer, W. S. Metcalf.

## MISCELLANEOUS.

**Quebec.**

MONTREAL.—Messrs. Coste, Desbarats, Holgate, Kennedy, Cowie, and St. Laurent, the members of the Board of Engineers who are considering plans for the improvement of the Port of Montreal, will meet this week to draft a report which will deal with the enlargement of docking facilities, increase in elevator capacity and deepening of the harbour channel so as to accommodate heavy draft steamers.

MONTREAL.—The Mayor of Ville St. Louis has been authorized to sign a contract whereby the C.P.R. and Montreal Street Railway will agree to subscribe $50,000 each for the construction of a tunnel under the C.P.R. tracks on St. Lawrence Boulevard, near Mile End.

ST. FELICIEN.—The new Carbonneau Bridge, situate at St. Felicien, eighteen miles from Roberval, was opened a few days ago. It is of the familiar closed-in type, something like the old Victoria Bridge, but is built entirely of wood. The bridge is 1,364 feet long, comprising ten spans, built ten feet above extreme high water. It was started eight months ago by the Provincial Government, from plans prepared by Mr. J. N. Castonguay, provincial engineer, who estimates that unless the bridge should be destroyed by fire it will be good for a century to come.

**Ontario**

BERLIN.—New tenders for paving King Street have been invited by this municipality. Mr. W. M. Davis is the city engineer

OTTAWA.—The engineers in charge of the plans for the reconstruction of the Quebec Bridge have reported to the Minister of Railways that the question as to whether or not the new bridge shall be of suspension or cantilever design is simply a matter of cost. Both plans are feasible, and a decision as to which plan will be adopted will be reached within a fortnight. In the meantime it has been decided to remove one of the piers on the north side of the river and to enlarge the pier on the Levis side. The pier on the north

side will be replaced by one which goes down to the solid rock, twenty-five feet below the gravel bed, on which the present pier rests.

PORT ARTHUR.—Good progress is being made with the construction of the Western Drydock and Shipbuilding Company's plant. In order to make the excavation necessary outside the shore line a coffer dam is being built necessitating 700 feet of crib work. Five hundred feet of this has been completed and now the work of putting it in position has been started.

**Manitoba.**

WINNIPEG.—With the completion at Point Roberts, last week, of the work of a party of government engineers, there is in existence for the first time a complete and accurate survey of the boundary line between the Dominion of Canada and the United States from Eastport, Me., on the Atlantic to Cape Flattery on the Pacific coast. The boundary survey has been carried on under the direction of a committee authorized by the United States Government three years ago, and working in conjunction with a like committee named by the Canadian government.

**Alberta**

FRANK.—At Bellevue, the West Canadian Collieries is putting in a new steel plant with air haulage and new railroad yards involving an expenditure of $250,000. The Canadian American company at Frank also is planning for big future operations and will, in the spring, begin the construction of a new plant and the building of coke ovens on which the outlay will run to between $300,000 and $400,000. These plans include the building of a new sanitarium building at the Frank sulphur springs to cost $60,000.

**British Columbia.**

NORTH VANCOUVER.—Detailed estimates of the cost of making improvements in the West Capilano district include the following items: Clearing, $4,100; grubbing, grading, etc., $40,000; rock-cutting, $72,500; bridging, $47,520; general improvement of Keith Road from western city boundary to Eagle harbour, $16,060; contingencies, $18,000. Total, $198,180. Tenders are invited for road improvements which will be done on the local improvement plan.

NEW WESTMINSTER.—Work has commenced on the setting of the massive centre casting for the swing pier of the new Lulu Island bridge. The south span has been rivetted in position and part of the draw span has been rivetted. The work can now proceed until it comes to the laying of the flooring, which cannot be done on the steel portion until the arrival of the sidewalk brackets. The International Contract Company is also laying the track for the British Columbia Electric Railway line across the bridge. Work on the draw protection has been suspended until such time as the old bridge is removed. It is expected that in about two weeks from now it will be necessary to close the North Arm to navigation.

**Yukon.**

DAWSON.—The last of the government road construction crews in the territory will have finished its work for the season, and will reach Dawson in a few days from the Black Hills. Fifty thousand dollars have been spent on construction of new roads in the territory recently.

## PERSONAL NOTES.

MR. G. H. HERRIOT, B.Sc., of Souris, Man., has been appointed to be a lecturer in Mathematics by the School of Mining, Kingston.

MESSRS. WATSON, JACK & COMPANY, 709 Power Building, Montreal, have been appointed agents for the Province of Quebec for the Polson Iron Works, Ltd., Toronto.

MR. B. J. HARPELL, 24 Aikins Building, Winnipeg, has been appointed Western Canadian agent of Glaholm & Robson, Ltd., Sunderland, England, manufacturers of wire rope of every description. Mr. Harpell has also secured the agency in Western Canada of the Richmond Safety Gate Company, Richmond, Ind., manufacturers of automatic and semi-automatic elevator gates, and all kinds of fire doors.

MR. J. NIBLOCK of the C.P.R., superintendent of the Calgary division, retired from the service November 1, after 35 years of railroading, 30 years of which he has spent in the West. He has been the Calgary superintendent since 1896, having gone there when headquarters were removed from Medicine Hat. Mr. C. S. Maharg, now superintendent at Medicine Hat, will fill the vacancy, while Mr. J. G. Taylor, at present superintendent at Moose Jaw, will take Mr. Maharg's place at Medicine Hat, and Mr. W. J. Urn, superintendent at Brandon, will be moved to Moose Jaw.

THE DUCKWORTH-BOYER ENGINEERING AND INSPECTION COMPANY, LTD., of Montreal, have taken over the business of Mr. Walter R. Duckworth, C.E., Inspecting Engineer, and have arranged with him to act as president and manager of the company. Mr. Duckworth is a graduate of McGill and an Associate Member of the Canadian Society of Civil Engineers. His past record of twelve consecutive years as chief inspector for the Dominion Bridge Company ranks him as an expert in this line of engineering. Mr. Aurelien Boyer, a graduate, with honours, of L'Ecole Polytechnique and an Associate Member of the Canadian Society of Civil Engineers, will act as vice-president. Mr. Boyer some years ago left the civil service in Ottawa, where he was occupying one of the best positions as engineer of the Department of Public Works, to extend his field of knowledge and acquire more experience. Before joining this company he was acting as Chemical Engineer and Superintendent of the works of Montreal industries. The company will give special attention to the inspection of bridges and structural work, tests of materials of construction; and reinforced concrete work, also expert examination and reports.

MR. F. W. COWIE, M. Can. Soc. C.E., of Montreal, will probably deliver a course of lectures on Harbour Engineering, before the fourth year students in the Faculty of Applied Science at McGill University. Mr. Cowie has had experience, which marks him as by far the man best fitted to deliver such a course of lectures. On his graduation from McGill in 1886, he at once entered the engineering offices of the Montreal Harbour Commission, transferring after some years to Ottawa. Later he had experience about the ports of the Great Lakes and also made a study of inland navigation. Some thirteen years ago he was appointed ship channel engineer for the St. Lawrence, where he had charge of much of the great improvement work which has been accomplished; and in 1907, resigned that position to become chief engineer for the Harbour Commission, Montreal. He accompanied Major Stephens on an extensive trip to study the chief ports of Europe and the work which these two gentlemen prepared on their return, is recognized as one of the most valuable on the subject ever published. More recently, Mr. Cowie drew up one of the two great plans for the improvement of the harbour of Montreal, which are now under consideration of a board of expert engineers.

## MARKET CONDITIONS.

Montreal, November 3rd, 1909.

The United States is again going through the excitement experienced in 1903 at the beginning of the prolonged boom in iron and steel material. Notwithstanding the fact that there is in the neighborhood of one million tons of pig-iron he'd in store by various interests, coupled with the circumstance that output is to-day greater than at any other time in history, such is the confidence of consumers that prices are going up by leaps and bounds under the demand which is coming along from all parts of the country for all grades of metal. Standard Bessemer iron could be purchased in June at $14.50 per gross ton, Va'ley furnace; it is now selling readily at $19 per ton, for prompt delivery, with an advance of 50c. to $1 per ton asked for delivery during next year. Foundry and basic grades have advanced in proportion and the tendency is still upward. The reasons for this advance are several, among which is the increased cost of raw material, such as ore and coke. Prices of Lake Superior ore have not yet been fixed for next year, but it is fully expected that it will be advanced at least 50c. per ton. Practical'y two tons of ore are used to make one ton of pig iron, thus adding $1 to the cost; coke prices are fully $1 per ton higher than they were two months ago and, approximately one ton of coke is used to make one ton of pig, another dollar is added to the cost of pig. Thus ore and coke will alone account for fully $2 of the advance, the balance being made up of increasing demand made on available supplies of metal. The railway companies, which have been the most backward interests during the year, are again coming into the market liberally for locomotives and cars, and large quantities of rails, this circumstance alone accounting largely for the improved condition. But there seems to be no feature of the trade which is lacking in confidence and enthusiasm.

The English and Scotch markets, while not so excited as those of the United States, are showing a decided improvement. Scotch producers of pig-iron have recently got together, but have not been able to advance prices materially, although it is impossible to secure concessions on any tonnage for prompt shipment. Some are declining to make contracts for large deliveries during 1910. The English market is now at a higher point than at any time during the past two years, and as numerous enquiries are

now before English makers and merchants, for shipment to United States Atlantic ports, it is believed that a further upward movement will be experienced almost immediately. Already several cargoes have been arranged for delivery at Philadelphia, and negotiations are under way for shipments to New York and Boston.

From the Continent come reports, for the first time in many months, indicating an optimistic tone in Germany and Belgium. While not materially higher, prices are certainly on the up-turn, and, with prospects for a firm business ahead, the indications point to higher prices all round. General market conditions in these countries are also showing signs of improvement, which would have the tendency of creating a demand for iron and steel materials and thus warrant better prices for manufacturers.

Locally, everything points to a decided improvement, not alone in prices but in the volume of business. From all points of the country, good enquiries are being received, and as the market is almost bare of pig iron, consumers are being compelled to pay advanced prices for prompt delivery. They will, however, without doubt, be called upon to pay considerably higher prices for tonnage which they may need to contract for later on for 1910 delivery. Canadian furnaces are pretty well occupied and for the most part cannot take on additional orders for delivery during the present year. Telegraph and telephone orders are being received by merchants, urging them to make immediate delivery of orders which purchasers were of the opinion they would not require for a considerable time to come.

Notwithstanding the strength of the situation in pig iron, merchants handling finished and semi-finished iron and steel products fail to find the strength uniform in their markets. For instance, steel plates have been almost easy in tone and it is quite possible that figures quoted some months since might be shaded, even, at the present moment. In bar iron and steel, however, the situation is otherwise, and the mills report that advances are now not far away. This will mean much to the general hardware market which has shown few alterations for some time past. During the past week, there have been advances in nails and spikes, and galvanized iron is a shade higher, chain, also, being quite a little dearer. The market generally is stronger.

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.90; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $4.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11 50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $118.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2 20 for 3-16; $2.30 for ¼, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 4-gauge, $2.15; and 10-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb., 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb., wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10¼c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¾-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are firmer at $2.45 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32½ to 33c.

**Zinc.**—The tone is steady, at 6 to 6¼c.

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Toronto, November 4th, 1909.

An increased activity is observable in many departments of business, and as a rule the trend of prices is upward. In iron and steel goods, since the recent difference between producers of these in Britain and the States, the market is on the rise, and from reliable information the price at point of production has already advanced. Higher prices may be looked for here in sheets, and it might be well to book requirements now.

In building materials, lumber is steady, brick firm and active, cement unchanged from former quotations. Roofing felt is active, building paper quiet, pitch and tar normal, all without change of quotation. The Manitoba and Western demand for these goods is much brisker than that in Ontario.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Osbawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke $5.25 to $5.50.

**Copper Ingot.**—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite**, per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs. Much is being now used for lumber camps.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.** ¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.** Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76. 4½-inch, $38; 5-inch, $43.50; 6-inch, $56 Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, $3 to $3.10; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60.

**Nails.**—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—Dealers report a large demand, the prices being as before, per catalogue

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10x16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12¼c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... .... | | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1½ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—We do not alter prices as yet; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a good demand exists, and there is prospect of higher prices.

**Sheets Galvanized.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. Demand very active.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10¼c. Cammel-Laird, 16c. "H R D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen, set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $2.1 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

### CAMP SUPPLIES.

**Beans.**—Hand picked, $2; prime, $1.85; Rangoon, $1.80.

**Butter.**—Dairy prints, 21 to 22c.; creamery rolls, 25 to 26c.

**Canned Goods.**—Peas, $1.10 to $1.15; tomatoes, 2s, 85c. to 95c.; pumpkins, 3s, 80c. to 85c.; corn, 2s, 85c. to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.80 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand, new cheese, large, 12¼c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12¼c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 5¼ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7¼c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 9½c.

**Eggs.**—New laid, 25 to 26c. per dozen, in case lots.

**Lard.**—Scarce and higher. Tierces, 16c.; tub, 16¼c.; pails, 16½c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 75c. a bag.

**Pork.**—Market uncertain. Short cut, $27.50 per barrel; mess, $26, nominal; no stock here.

**Rice.**—B grade, 3½c. per lb.; Patna, 5¼ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 14½ to 14¾c.; breakfast bacon, 17c.; backs (plain), 18 to 19c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked. Market very firm.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

**Sugar.**—Granulated, $4.75 per 100 lbs. in barrels; Acadia, $4.65; yellow, $4.35; bags, 5c. lower; bright coffee, $4.55; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, November 2nd, 1909.

Conditions in the West remain very satisfactory as far as building operations are concerned; and all trades connected with it are working up to full capacity. Carpenters are in demand, and there is, if anything, a shortage in the labor market. Orders are coming to hand from country merchants for shelf and heavy hardware, and in Winnipeg there is reported to be a shortage of small, iron pipe caused by the large amount of this material being used for the installation of May-Oatway Fire Alarm Systems. There seems to be no let up in the number of propositions being considered, and there is no shortage of capital in the West this year for this purpose. Coal dealers are very busy; but the price of coal is unchanged, and there is scarcely any change in quotations of the different lines of coal on this market. Cement is quiet, with prices remaining steady. The iron working factories are still busy, and taking the season just closed which has been the best in their history for the amounts of contracts completed.

Winnipeg quotations are as follows:—

**Anvils.**—Per pound, 10 to 12¼c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

**Copper Wire.**—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; 5⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4½c

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

(Continued on Page 40.)

# The Canadian Engineer

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## The Canadian Engineer

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## THE STATUS OF THE ENGINEERING PROFESSION.

During the past few months the British engineering journals have devoted columns to this question. Every gathering of engineers has taken time to discuss the shortcomings of the profession. Co-operation, legislation, Government examination and a closed corporation have all been urged as a solution for the real difficulties that face members of the engineering profession.

The function of the engineer covers so wide a field, from power supply to waterproofing of cement, from the purification of water supply to erecting a railroad bridge, from erecting wireless telegraph stations to designing seawalls, the interests of engineering are so diverse that reconciling and marshalling under one organization, directed by a common law and common custom will be an immensely difficult task.

In Canada, to-day, anyone may call himself an engineer without incurring any risk if he fails to possess adequate qualifications. If he has enough commercial sense and talent for organization he may easily secure the commission for large engineering work, knowing well that for small pay he can engage men of high scientific and professional attainments to work out the details. When he does this, little is heard of the venture, but the practice has grown, and now men without either engineering knowledge or the business sense to surround themselves with competent men accept work they are not fitted for. Following this is disaster. Money is wasted and the profession held up to ridicule, and everyone feels competent to criticize the engineer.

The authority of the nurse, the dentist, the doctor, or the lawyer is never questioned. They say "do this," and we do it, never doubting. But because of the failures of those calling themselves engineers the non-technical official does not hesitate to override the opinion of competent engineers.

Some day this may be remedied in part by legislation, but until that day does come the engineering societies of Canada should consider their combined duty to protect the genuine members of the profession and expose the promoter who calls himself an engineer. Money spent in exposing fake schemes and unprofessional conduct would bring good returns.

## UNITED STATES OCTOBER IRON OUTPUT.

Remarkable as was the September output of iron in the United States, according to the "Iron Age" the October output will far surpass it.

The steel companies produced 1,766,162 tons in October, or 56,973 tons a day against an average of 55,361 tons in September. The merchant furnaces increased their daily rate of 24,146 tons in September.

All this means an increased activity in the foundries, rolling mills, pipe and rail mills.

A general advance in prices is looked for.

## THE INTERCOLONIAL RAILWAY.

It is unfortunate that protest is being made against the new management of this road, which, for so many years, has been handled more as a political toy than a commercial enterprise.

For the twelve months ending March 31st last the Working expenses were ..... $9,328,021
Revenue ..... 8,527,069

Loss on operation was ..... $ 800,952

Or, in other words, it cost $1.09 to earn $1.00.

The road connects Montreal with some of the best country to the south and east, and all the way to Halifax runs through a district that is revenue producing.

The old order must not be restored. It is now free from political interference, and there is every reason to expect that the present management will operate it as a railroad existing for and by traffic.

## EDITORIAL NOTES.

The Grand Trunk Pacific Railway (National Transcontinental) from Winnipeg to Superior Junction was opened on November 6th by the passing over the line of an official train.

* * * *

The C.P.R. Western Division claims the record for rapid freight car despatching. Recently a freight car was loaded at Lauder, Man., shipped to Fort William, unloaded, sent back to Lauder, loaded, and again hauled to Fort William, in six days making three trips and 1,785 miles.

* * * *

In view of the frequent discussion about the disappearance of Ontario forests, the increased spring run-off and water storage in swamps, etc., the report of the Ontario Bureau of Industries is of considerable interest. The area of land in Ontario is 141,125,120 acres. Referring to the organized districts of Ontario, the assessed acreage is 24,497,406. Of this, 14,132,061 acres are cleared, or 57.69 per cent. Of the remainder, 5,331,654 acres is woodland, 2,273,251 acres slash, and 2,760,440 acres marsh or waste land. Since 1899 the per cent. of cleared land in the assessed districts has increased from 55.91 to 57.69.

To Mr. Acton Burrows, the veteran editor of the "Railway and Marine World," we wish to extend our sympathy in his hour of great bereavement. We cannot see the darkness which he sees nor know the sorrow which he now knows. We do hope that the weeping, lowering clouds may soon pass.

## PRECIPITATION FOR OCTOBER.

In British Columbia the precipitation recorded during October was generally in excess of the average. This was also the case in Eastern Quebec and the Maritime Provinces, excepting in Southwestern Nova Scotia, where the normal value was not reached. Throughout the remaining districts of Canada, the fall, with local exceptions, was less than average, the deficiency being particularly marked in the Western Provinces, where the amount was about half the average.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for the month.

Ten inches of snow is calculated as being the equivalent of one inch of rain.

| Station. | Depth in inches. | Departure from the average of twenty years. |
|---|---|---|
| Calgary, Alta. | 0.60 | + 0.12 |
| Edmonton, Alta. | 0.30 | — 0.41 |
| Swift Current, Sask. | 0.30 | — 0.45 |
| Winnipeg, Man. | 0.50 | — 1.11 |
| Port Stanley, Ont. | 1.20 | — 1.68 |
| Toronto, Ont. | 1.14 | — 1.29 |
| Parry Sound, Ont. | 4.40 | + 0.52 |
| Ottawa, Ont. | 1.10 | — 1.47 |
| Kingston, Ont. | 2.10 | — 0.64 |
| Montreal, Que. | 0.90 | — 2.26 |
| Quebec, Que. | 2.20 | — 0.98 |
| Chatham, N.B. | 6.20 | + 2.43 |
| Halifax, N.S. | 7.10 | + 1.59 |
| Victoria, B.C. | 2.30 | + 0.07 |
| Kamloops, B.C. | 0.50 | + 0.04 |

## SOCIETY NOTES.

### ENGINEERING SOCIETY FACULTY OF APPLIED SCIENCE, TORONTO UNIVERSITY.

At the last regular meeting of the Engineering Society of the Faculty of Applied Science, Toronto University, Mr. T. Kennard Thomson, M. Can. Soc. C.E., and a graduate of the class of '86, addressed the members on "Foundations for High Buildings." Mr Thomson said in part, when referring to the clearing of the ground:—

T. Kennard Thomson, M. Can. Soc. C.E.

The usual practice is to sell the old buildings to house-wreckers for a small amount, the wrecker selling as much of the material as possible at second-hand. In many of the old five or six-storey buildings the salvage value does not amount to much, while some of the newer buildings have a considerable number of iron beams and columns which bring good prices. On the other hand, in the old buildings which were put up with lime mortar many of the bricks can be removed and used over again; while in the more recent buildings, laid with Portland cement mortar, the bricks are almost entirely destroyed in the removal, that, too, being accomplished at a great expense.

In connection with difficulties in caisson work, he mentioned that in small caissons the weight of the air lock is a very considerable item, and, therefore, it is very important to have the shaft truly vertical in order to have the weights concentric with the caisson to prevent the caisson from getting out of plumb, and this is much more difficult than might be supposed, for in the first place the shafts are not always absolutely true, and are not always perpendicular to the deck when bolted on, and then hemp or other kinds

of gaskets are used at the joints, permitting, sometimes, one side to be bolted a little tighter than the other, throwing the whole out of line.

Many interesting slides were shown in connection with his work in New York, and particularly the Manhattan Life Building.

The following is the proportion of the actual cost of the various items on this building, the contractor's profit and loss item, for obvious reasons, being proportionate to each item:—

| | Per cent. |
|---|---|
| Labor at site | 41.6 |
| Lumber | 3.3 |
| Fuel and oil | 1.6 |
| Hauling | 5.5 |
| Cement | 6.3 |
| Crushed stone | 2.9 |
| Sand | 1.0 |
| Steam and electricity | 2.3 |
| Supplies | 6.2 |
| General expense | .8 |
| Shafting, etc. | 2.3 |
| Waterproofing | 3.1 |
| Caisson material and labor | 23.1 |
| | 100.0 |

Summing the work up, we get the following proportions:—

| | Per cent. |
|---|---|
| Caisson work | 75.8 |
| Excavating cellar, etc. | 11.4 |
| Concreting floor | 2.1 |
| Concreting cantilever and grillages | 2.1 |
| Waterproofing | 3.1 |
| Extra work | 5.5 |
| | 100.0 |

* * * *

**Engineers' Club of Toronto**

At the meeting held last Thursday evening, Mr. A. B. Barry, president of the Club presided. The question of changing the Constitution with a view to admitting to associate membership, men who are not engineers by profession, but whose pursuits qualify them to co-operate with engineers in the advancement of professional knowledge, was discussed at some length, and the meeting finally decided to let the matter stand in abeyance until the annual meeting. A proposed amendment to clause 8, having reference to increasing the annual dues for resident members from $5 to $7.50, was also postponed. Suggestions for making the meetings more interesting were made and considered, and sundry other business transacted. Mr. Chas. B. Fox, M. A., of Wragge & Fox, civil engineers, Toronto, was admitted to membership.

* * * *

On Thursday evening, November 4th, Professor Nobbs, of McGill University, delivered an interesting lecture before Montreal members of The Canadian Society of Civil Engineers, on "The Aesthetics of Design."

Eleven persons on the average have been injured daily and one person has been killed every other day for the last three months by the Chicago street cars.

## THE SERVICEABLE LIFE AND COST OF RENEWALS OF PERMANENT WAY OF BRITISH RAILWAYS.*

By R. Price-Williams (London).

Mr. Richard Price-Williams was born at Stoke Newington, London, and educated at a school at Bridgend, where he had a schoolfellow the late Sir James Douglas, the eminent engineer to the Trinity House, who constructed the Eddystone Lighthouse. Among the important posts held by Mr. Price-Williams was that of manager and constructor of Fox & Company's Bessemer steel rail works near Sheffield, and subsequently manager and part constructor of Bessemer Brothers' works at Greenwich. He served his pupilage under the late George Heald, M. Inst. C.E., and afterwards served as an apprentice at Kitson's locomotive works at Leeds. Subsequently he became a consulting engineer, designing and preparing plans, sections and estimates for the construction of the Metropolitan Outer Circle Railway and of the London & Eastbourne Railway. Later he was engaged in surveying and preparing plans and estimates for the construction of the Midland of Western Australia Railway from Perth to Geralton. Mr. Price-Williams was appointed by the Royal Commission on the Coal Supplies, in 1871, to prepare estimates of their duration, and retained by the recent Royal Coal Commission to prepare and give evidence on the same subject. He is a member of the Institution of Civil Engineers, and many years Member of Council of the Institution of Mechanical Engineers; Fellow, and for many years Member of Council, of the Royal Statistical Society; author of papers read at the Royal Statistical Society on the "Coal Question," and on the "Population of England and Wales," (1801-81); "Population of London," (1801-81); and on the "Railway Rates and Charges Acts of " 1896; also of papers on the maintenance and renewals of permanent way, rolling stock and waterworks, for each of which he was awarded a Telford (1866), (Watt 1870), George Stevenson (1902), Gold Medal by the Institution of Civil Engineers, and awarded in 1898 the Bessemer Gold Medal at the special request of Sir Henry Bessemer.

According to the Board of Trade Railway Returns (1907) there are, roundly speaking, a little over 23,000 miles of railway open for traffic in the United Kingdom, of which about 13,500 miles consist of double and more lines, and about 10,250 miles of single lines, besides which there are 14,000 miles of sidings. The total annual cost of the maintenance and renewal of the permanent way and works amounted to, roundly, eleven millions sterling, nearly 15 per cent. of the entire working expenses, which have now and for some years past reached the exceptionally high figure of nearly two-thirds (63 per cent.) of the entire railway gross receipts.

In this paper the cost of the maintenance and renewals of the permanent way of fifteen of the principal British railways, having an aggregate of 15,184 miles of railway (equivalent to about 80 per cent. of the total mileage of the railways in Great Britain), will alone be dealt with, particulars of which expenditure have been furnished during the last ten years in some valuable tables in the C Appendix to the Board of Trade Returns. From these have been obtained the data from which the results in Table V. in this paper have been compiled, giving in the case of each of these fifteen railways the expenditure in each year in wages and material, in the renewals of the permanent way, and also the average annual cost of renewal in terms per mile of railway

*Read at the Iron and Steel Institute, Great Britain.

considered—as a railway must necessarily be, whether a double or single line—as a thoroughfare for the conveyance of railway traffic. From a reference to the table in question, it will be seen that the average cost of renewals per mile varies from an average maximum of £418.18 per mile during the ten years, in the case of the London, Brighton, and South Coast Railway, to a minimum of £190.80 per mile in the case of the North British; while the tonnage of goods and minerals per mile in the latter case is just double that of the London, Brighton, and South Coast. In another case, that of the Lancashire and Yorkshire Railway, with a maximum tonnage of 41,078 tons per mile of goods and mineral traffic, the average annual cost of renewals is only £291.-07 per mile, very little above the average. Again, in the case of the London and North-Western, with the large tonnage of goods and minerals of 26,493 tons per mile, the average cost of renewals is as much as £335.95 per mile, as compared with the North-Eastern Company's average of only £236.26 per mile, with its heavy tonnage of 36,004 tons per mile of goods and minerals. Next comes the London and South-Western, with its average cost of renewals much above the average—namely, £319.47 per mile, with the smallest average of 6,735 tons per mile. It is clear, therefore, that we must look for something more than the mere weight of tonnage to account for the exceptionally large cost of renewals of the permanent way of some of the principal British railways, and there is everything to indicate that it is mainly due to the greatly increased weight and speed of the passenger traffic which has occurred since the introduction of the better and much more durable material of steel rails, and partly to the increased weight and speed of the goods and mineral traffic. In this connection it will be as well to advert to the cost of the maintenance and renewal of the permanent way at the period almost immediately preceding the first introduction of Bessemer steel rails in the early 'sixties, particulars of which were furnished to the author by the chief executive of nine of the principal British railway companies at the time of the reading of his paper on the "Maintenance and Renewal of Permanent Way" at the Institution of Civil Engineers in 1866, a copy of which statement is given in the accompanying Table I. Side by side with this is given, for

**Table I.—Maintenance and Renewals of Permanent Way of Nine Principal British Railways.**

| Railway. | 1847 to 1865. Average Miles Open. | 1847 to 1865. Amount of Renewals. | 1847 to 1865. Average Cost per Mile. | 1865 to 1875. Average Cost per Mile. | 1897 to 1906. Average Miles Open. | 1897 to 1906. Cost in Ten Years. | 1897 to 1906. Average Cost per Mile. |
|---|---|---|---|---|---|---|---|
| L. & N. W. | 755.6 | 1,906,853 | 253.36 | 307.53 | 1933.4 | 6,495,262 | 335.95 |
| N. Eastern | 762.1 | 867,586 | 131.05 | 232.01 | 1658.9 | 3,918,235 | 236.26 |
| Midland | 546.6 | 775,750 | 141.92 | 311.26 | 1455.3 | 5,165,796 | 354.96 |
| L. & S. W. | 315.6 | 288,661 | 93.59 | 251.41 | 921.5 | 2,943,896 | 319.47 |
| Gt. Northern | 276.6 | 392,992 | 141.57 | 299.88 | 928.8 | 2,203,875 | 265.91 |
| Lanc. & Yorkshire | 255.4 | 368,924 | 361.07 | 397.07 | 465.2 | 1,645,094 | 291.07 |
| S. Eastern & Chatham | 248.8 | 436,093 | 173.23 | 257.05 | 718.4 | 2,131,896 | 344.74 |
| L., B. & S. C. | 180.6 | 219,511 | 121.51 | 249.31 | 448.6 | 1,875,982 | 418.18 |
| M. S. & L. & Gt. Central | 160.2 | 85,[illegible] | 53.53 | 271.29 | 500.7 | 1,721,845 | 318.39 |
| Total and Averages | 3,401.1 | 5,706,135 | 178.40 | 285.53 | 8930.8 | 28,101,881 | 314.66 |

the purpose of comparison, the average annual expenditure and cost per mile of the renewals during the first ten years from 1865 to 1875 after the adoption, or partial adoption, of steel rails, and also of the present cost of the renewal expenditure of these nine railways as obtained from the returns of the fifteen British railways alluded to.

The total cost of the renewal of these nine principal railways with iron rails during the eighteen and a-half years prior to 1865, with an average aggregate of 3,401 miles of way, only amounted to £5,706,135, and to an average of £170.40 per mile of way. It rapidly increased during the first ten years, after the first partial introduction of steel rails, to £285.53 per mile, partly owing, no doubt, to the high price then of steel rails. Notwithstanding the great subsequent reduction in the price of steel rails to a lower figure than even the best iron rails, the expenditure in the renewal of way on these nine principal railways has, however, now reached an amount of £28,101,881, and £314.66 per mile of railway, during the short space of the last ten years—a fivefold increase in amount and now double the cost per mile in renewals—the mileage of these nine railways having increased from 3,401 to 8,930.

The development of railway traffic since the introduction of steel rails has been enormous, as the few figures given in Table II. testify:—

**Table II.—Railways in United Kingdom.**

| Years. | Miles Open. | Gross Receipts. | Working Expenses. | Net Receipts. | Passengers. | Goods and Minerals. | Carriages and Waggons. |
|---|---|---|---|---|---|---|---|
| | | £ | £ | £ | No. | Tons. | No. |
| 1907 | 23,168 | 121,548,323 | 76,609,194 | 44,830,729 | 1,259,481,315 | 515,887,116 | 810,416 |
| 1860 | 10,433 | 27,766,622 | 13,187,368 | 14,579,253 | 163,435,678 | 89,857,719 | 195,650 |
| Inc. | 12,675 | 93,782,301 | 62,421,826 | 30,260,470 | 1,096,045,637 | 426,029,397 | 614,766 |

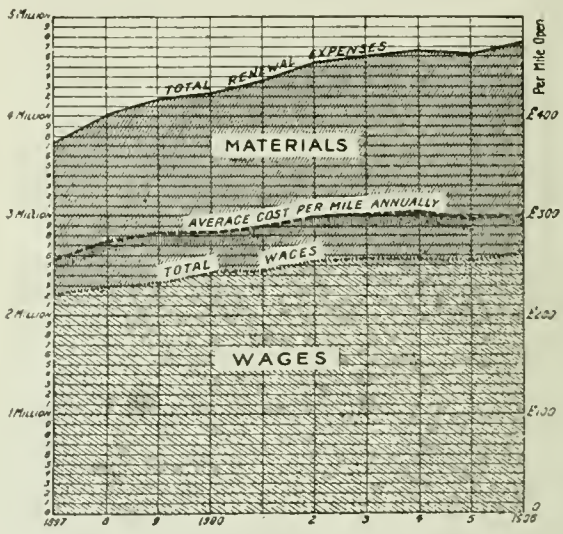



**Fig. 1.—Ten Years' Permanent Way Renewals of 15 Principal British Railways.**

While the mileage during the last forty-seven years has only a little more than doubled, the working expenses have increased nearly sixfold, the number of passengers carried has increased nearly sevenfold, the tonnage of goods and minerals carried has increased nearly fivefold, while the number of carriages and wagons has only increased threefold; no doubt a considerable portion of the increase of the permanent way expenses is mainly due, as already stated, to the very large increase in the weight and speed of the passenger traffic, and partly to the very large increase in the tonnage of goods and mineral traffic, and also in some degree to its somewhat increased speed.

That the much greater strength and durability of the high-class of steel material of which Bessemer steel is the type, has largely contributed to the exceptionally rapid growth, not only of railway traffic in this country, but of its trade and commerce generally, there can be no question. No more striking recognition of this could better be given than was recently so felicitously afforded by the King in the handsome tribute His Majesty paid to the late Sir Henry Bessemer,

to whose discovery of the process which bears its inventor's name he so justly attributed the remarkable development of engineering industries during the last fifty years.

This exceptionally rapid increase of railway traffic during the period in question, however, was never anticipated, even by the most sanguine believers in the new process, including the author himself, and the effect of it is, it must be admitted, somewhat to discredit the estimates then made of the capability of the steel rails enduring the destructive effects of the wear and tear of the traffic for the long periods of time anticipated. This in no way detracts from the high character of the steel material, which has at least maintained all its fine qualities, and great improvements have since been made in the process of the manufacture, and large reductions in the price of the material.

As the records of the Institute proceedings testify, an intimate knowledge of the constituents of the material has been obtained by chemical analysis; but what in the case of steel rails are conspicuous by their absence in all these analyses are particulars of the physical qualities of the steel, and the amount of the tonnage and of the speed of the trains to which the rails have been subject, together with an exact measure of the wear of the rail-head during a given period.

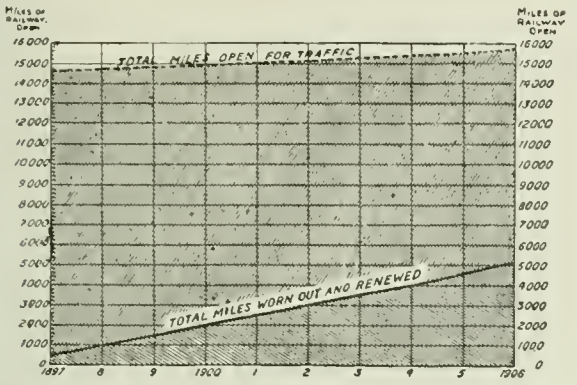



**Fig. 2.—Mileage Open of 15 British Railways.**

Full information on these points, together with Mr. Riley's chemical analyses and the late Mr. Kirkaldy's physical tests, are given in the author's paper read at the Institution of Civil Engineers in 1866. Several methods have been adopted for ascertaining the amount of wear of the rail-head at an early period, notably that of the late James Price, M. Inst. C.E., by means of a sort of 40-ft. turn-table, the rails of which were subjected to the wear of wheels loaded with given weights rotating at definite speeds round the 40-ft. table, which gave approximately the amount of abrasion of the rail-head and check of the rail on a circular curve. Recently two other very ingenious methods were described in papers read at the Institute—one by Dr. Stanton, and the other by Mr. Saniter; but in none of these cases is any account taken of some of the most destructive effects which rails are subject to in practice, such as that of impact, the oscillations and concussions of the train, particularly on curves, the shearing away of the rail-head metal in flakes, and other effects. The late Professor De Morgan, of London University, stated to the author that in he case of a train travelling at a great speed on a curved line, the oscillations and concussions partook of the character of a projectile fired from a curved cannon, and must be of a most destructive character.

In view of these facts, the author considers that nothing short of the actual experience derived from a careful register of the number, character, weight, and speed of the trains on those portions of a railway most severely worked will suffice to afford the requisite information.

The manufacturers of steel rails, to their great credit, have done all in their power to improve the quality and to increase the durability of the material; it behooves the railway engineer to see that this part of the business is carefully seen to. The result will, in the author's opinion, lead to large economies. No one, however, with any experience of railway working but must admit that the principal railways in this country are maintained in a thoroughly standard condition of efficiency for working the constantly increasing traffic, as is testified by the large annual amount per mile expended on maintenance and renewals.

As already stated, the working expenses of railways in the United Kingdom have now reached the exceptionally high average of nearly two-thirds of the gross receipts, whereas in 1860, the date immediately preceding the introduction of the Bessemer steel rail, the working expenses only amounted to 47 per cent. of the gross receipts, and during the previous twenty years which the author can recall, they had scarcely ever exceeded what in nearly all other great and well-administered commercial undertakings is regarded as the requisite normal expenditure of 50 per cent. It is not the purpose, however, of this paper to deal with this aspect of the question, but it is as well to bear in mind that nearly two-thirds of the total working expenses of these British railways have exclusive relation to the great iron and steel industries which supply most of the material required not only for the permanent way, but for the locomotive stock and large portions

**Table III.—Ten Years' Working Expenditure of Fifteen Principal British Railway Companies, (1897 to 1906).**

| Class of Expenditure. | Wages. | Material. | Totals. | Per Cent. | Average Annually. |
|---|---|---|---|---|---|
| Conveyance. | | | | | |
| Maintenance and Renewals— | £ | £ | £ | | £ |
| Permanent Way ..... | 24,624,096 | 19,134,177 | 43,758,273 | 12.30 | 4,375,827 |
| Locomotive Stock .... | 21,098,706 | 19,985,914 | 41,084,620 | 11.56 | 4,108,462 |
| Carriages and Wagons. | 17,524,413 | 26,519,282 | 44,043,695 | 12.38 | 4,404,370 |
| | 63,247,215 | 65,639,373 | 128,886,588 | 36.24 | 12,888,659 |
| Locomotive running and Coal ..... | 50,954,022 | 47,511,494 | 98,465,516 | 27.68 | 9,846,551 |
| | 114,201,237 | 113,150,867 | 227,352,104 | 63.92 | 22,735,210 |
| Traffic Expenses ..... | 128,322,469 | ..... | 128,322,469 | 36.08 | 12,832,247 |
| | 242,523,706 | 113,150,867 | 355,674,573 | 100.00 | 35,567,457 |

of the material of the carriage and wagon stock, as will be seen from reference to Table III., all of which are purely engineering matters affecting the cost of conveyance of traffic apart from the question of the administration of a railway.

### Permanent Way.

The permanent way of a railway in its widest sense, as the word itself most fittingly betokens, recognises no period of finality for its existence, so long as it continues to be the best available means for the conveyance of passengers, goods, and mineral traffic. It serves as a thoroughfare between different places and centres of traffic, and is equipped with mechanical appliances requisite for the transport of such traffic. The permanent way in this sense does not comprise merely the steel rails, sleepers, cast-iron chairs, points, crossings, and ballast, involving only an annual charge for their maintenance and renewal; but all that is essential to ensure safety and security in the conveyance of passenger and other traffic, the renewal of which, although indisputably constituting the main source of the permanent way working expenses, includes also the renewals or partial renewals rendered necessary by the natural decay of the "works of line," and other structures at much more distant periods; and the variations in the serviceable life of steel rails on different portions of the permanent way, render it impossible to determine the

**Table IV.—Fifteen Principal British Railways, Ten Years' Maintenance and Renewal of Permanent Way Expenditure (1897 to 1906). Equivalent Mileage Annually Worn-out and Renewed.**

| Year. | Miles Open. | Wages. | Per Mile Open. | Materials. | Per Mile Open. | Total Expenditure. | Total Expenditure per Mile Open. Per Annum. | Total Expenditure per Mile Open. In Thirty Past Years. | Equivalent Miles worn out. Col. 7. / Col. 9. |
|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | |
| | £ | £ | £ | £ | £ | £ | £ | £ | |
| 1897 ..... | 14,009 | 2,208,558 | 151.22 | 1,520,225 | 104.09 | 3,728,783 | 255.31 | 7659.30 | 486.83 |
| 1898 ..... | 14,778 | 2,279,977 | 154.34 | 7,784,453 | 120.79 | 4,064,430 | 275.14 | 8254.20 | 492.43 |
| 1899 ..... | 14,811 | 2,333,775 | 157.57 | 1,843,111 | 124.44 | 4,176,886 | 282.01 | 8460.30 | 493.70 |
| 1900 ..... | 14,900 | 2,429,384 | 163.04 | 1,794,345 | 120.42 | 4,223,729 | 283.46 | 8503.80 | 496.67 |
| 1901 ..... | 15,043 | 2,434,552 | 161.84 | 1,935,507 | 128.66 | 4,370,059 | 290.50 | 8715.00 | 501.43 |
| 1902 ..... | 15,095 | 2,532,418 | 167.76 | 1,983,618 | 131.41 | 4,516,036 | 299.17 | 8975.10 | 503.17 |
| 1903 ..... | 15,264 | 2,587,784 | 169.54 | 2,021,299 | 132.42 | 4,609,083 | 301.96 | 9058.80 | 508.80 |
| 1904 ..... | 15,350 | 2,586,205 | 168.44 | 2,085,832 | 135.88 | 4,672,037 | 304.36 | 9130.80 | 511.67 |
| 1905 ..... | 15,527 | 2,586,584 | 166.59 | 2,063,201 | 132.88 | 4,649,785 | 299.47 | 8984.10 | 517.56 |
| 1906 ..... | 15,809 | 2,644,859 | 167.30 | 2,102,586 | 133.00 | 4,747,445 | 300.30 | 9009.00 | 526.96 |
| Totals and Averages .. | 151,186 | 24,624,096 | 161.89 | 19,134,177 | 126.58 | 43,758,273 | 289.47 | 8684.10 | 5039.22 |

serviceable life of the permanent way except in its entirety and considered as a whole. Considered, however, in that sense, the average annual expenditure in maintenance and renewals of the permanent way, in terms per mile of railway, whether it consists of double or single lines, during a sufficiently long period of years, is in reality the real equivalent of the annual death-rate of all classes of the perishable materials which constitute the permanent way of any railway. By way of illustration a period of thirty years may be fixed as a sufficient interval of time to obtain average and reliable results of the destructive effects of the wear and tear of traffic, and of the natural decay and exceptional causes necessitating complete renewal of the materials of all kinds. As will be seen from reference to the figures in Table IV., of the results obtained in the case of the fifteen principal British railways during the last ten years, means are afforded of determining very approximately the equivalent number of miles of permanent way and works of all descriptions which have become worn out and have been required to be renewed, so as to have enabled the permanent way of the particular railway to have been maintained in a thorough condition of efficiency for continuing the ceaseless and constantly increasing traffic of British railways. All, in fact, that is required —with the data now available of the actual annual expenditure per mile of railway of these fifteen railways during the past long period of years in question, taking thirty years as a definite and reasonable maximum limit of serviceable life of all classes of materials, subject to the destructive effects of wear and tear and of decay—is to multiply each year's annual cost of renewals per mile of railway by the past thirty years' fixed period, and to divide the total amount of renewals expenditure during the last ten years by it, and we get the equivalent number of miles of railway—whether double lines or more, or partly double and single, or exclusively single lines, of each of the fifteen railways. In the aggregate this amounts in ten years to 5,039 miles of railway—or, roundly, 504 miles annually—which have become worn out and have been replaced in most, if not all, cases with stronger and better materials, and as the traffic on these railways is still rapidly increasing, it may be satisfactory to the steel-rail manufacturers in this country to know that at least that quantity of worn-out steel rails will have to be simultaneously renewed during a similar period in the future. The permanent way of a railway—in fact, in its entirety, as has already been stated—has perpetual life, and it follows that every portion of it must necessarily share it also.

The late Sir John Hawkshaw, during the discussion on the author's paper in 1866 referred to, admitted that the improvements in the permanent way had not kept pace with the requirements of the rapid growth of railway traffic. It has since certainly been greatly improved and better maintained, and renewed with stronger and better materials, but on those portions of the main lines where there are junctions, and at all intermediate stations over which trains pass at high speeds without stopping, there are the knife-edged facing points and the main line rail crossings, more especially those known as the obtuse or diamond crossings, at all of which there is a gap in the main line rail, and they are all of the primitive types of crossing and switches as at the time Sir John Hawkshaw alluded to the permanent way in 1866. It is notoriously the fact that at these main line junctions and crossings, as the published records testify, some of the most terrible railway accidents have occurred. The recent very calamitous accidents at Salisbury and Shrewsbury junctions have since directed attention to great defects and risks at junctions when trains are travelling at the high speed now attained, and to the need in such places for curves of greater radius; but that involves the adoption of longer and much more attenuated knife-edges, facing points or switch tongues, sharper-angled crossings, and bigger gaps in the main lines. A method has been devised for dispensing with the gaps in the main lines and of rolling much stronger and larger and tapered facing points, which have been highly approved of by eminent engineers, amongst others notably by the late Sir Benjamin Baker and Sir Alexander Rendel, and especially by the late Sir Henry Bessemer; the only objection made is the greater expense, and that the present types can be more cheaply constructed. With railway expenses at nearly two-thirds of the gross railway revenue, economy is most desirable, but where risk of accident and danger to life can be avoided, saving of expense, as Sir John Hawkshaw said on the occasion referred to, is false economy, to say the very least of it.

In conclusion, the author trusts that the fact that it is the business of members of this Institute to supply by far the greater portion of the material required for the renewal of the permanent way and of locomotive and wagon stock, the expenditure of which has amounted in the short period of ten years to nearly £120,000,000, may be considered some justification for drawing attention to the subject of the permanent way of British railways.

**Table V.—Permanent Way Expenses. Ten Years (1897 to 1906).**

| Railway. | Miles Open. | Wages. | Materials. | Total. | Cost per Mile. Wages. | Materials. | Total. | Goods and Minerals Tons per Mile. |
|---|---|---|---|---|---|---|---|---|
| | No. | £ | £ | £ | £ | £ | £ | 1906. |
| Caledonian ..... | 990.3 | 1,547,549 | 1,050,957 | 2,598,506 | 156.27 | 108.15 | 264.42 | 22,677 |
| Great Central ..... | 500.7 | 847,972 | 873,873 | 1,721,845 | 156.77 | 161.62 | 318.39 | 45,198 |
| Great Eastern ..... | 1116.1 | 1,908,770 | 1,470,507 | 3,379,277 | 171.02 | 131.76 | 302.78 | 10,727 |
| Great Northern ..... | 828.8 | 1,424,090 | 779,785 | 2,203,875 | 171.83 | 94.08 | 265.91 | 22,819 |
| Great Western ..... | 2679.6 | 3,248,732 | 3,600,453 | 6,849,185 | 121.24 | 134.37 | 255.61 | 16,437 |
| Lancashire and Yorkshire. | 565.2 | 997,461 | 647,633 | 1,645,094 | 176.48 | 114.59 | 291.07 | 41,678 |
| London & North-Western.. | 1033.4 | 3,710,625 | 2,784,637 | 6,495,262 | 191.92 | 144.03 | 335.95 | 26,493 |
| London & South-Western.. | 921.5 | 1,498,624 | 1,445,272 | 2,943,896 | 162.63 | 156.84 | 319.47 | 6,738 |
| London, Brighton and South Coast ..... | 448.6 | 875,240 | 1,000,742 | 1,875,982 | 195.11 | 223.07 | 418.18 | 10,174 |
| Midland ..... | 1455.3 | 3,069,274 | 2,096,522 | 5,165,796 | 210.90 | 144.06 | 354.96 | 30,477 |
| North British ..... | 1278.5 | 1,632,015 | 808,570 | 2,440,585 | 127.65 | 63.24 | 190.89 | 21,176 |
| North-Eastern ..... | 1658.9 | 2,375,556 | 1,542,679 | 3,918,235 | 143.26 | 93.00 | 236.26 | 36,004 |
| South-Eastern & Chatham. | 618.4 | 1,260,209 | 871,687 | 2,131,896 | 203.79 | 140.95 | 344.74 | 9,880 |
| Taff Vale ..... | 123.1 | 197,053 | 148,760 | 345,813 | 160.07 | 120.84 | 280.91 | 153,860 |
| Totals and Averages .....15118.4 | | 24,593,170 | 19,122,170 | 43,715,247 | 162.68 | 126.48 | 289.16 | 24,298 |

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8476—October 26—Authorizing F. Violette, of St. Leonards, N.B., to lay and thereafter maintain a water pipe under the track of the C.P.R. near St. Leonards, N.B.

8477—October 26—Granting leave to the Manitoba Government Telephone to erect, place, and maintain its wires across the track of the C.N.R. at public crossing ½ mile north Neepawa Station, Man.

8478—October 27—Granting leave to the Wroxeter Rural Telephone Company to erect, place, and maintain its wires across the C.P.R. at Gibson Street, Wroxeter, Ont.

8479—October 27—Granting leave to the Hydro-Electric Power Commission to erect, place, and maintain its wires across the track of the C.P.R. in Township of Puslinch, County Wellington, Ont.

8480—October 27—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at Joliette Sand & Gravel Company's premises, near St. Felix de Valois, P.Q., at public crossing Albert Street, St. John's, P.Q.; and at private crossing at Cache Bay, Ont.

8481, 8482, and 8483—October 27—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at public crossing Albert Street, St. John's, P.Q., and at Cache Bay, Ont., also across the track of the P.M.R.R. at public crossing King Street, 100 yards east of Merlin Station, Ont.

8484—October 26—Authorizing the corporation of the town of Paris, Ont., to lay water pipe under the track of the G.T.R. where it crosses Market Street, Paris, Ont.

8485—October 19—Approving new Standard Mileage Freight Tariff of the New Brunswick Southern Railway superseding Standard Freight Mileage Tariff C.R.C. No. 1.

8486—October 19—Approving by-law of the Montreal and Southern Counties Railway authorizing W. B. Powell, general manager, to prepare and issue tariff of tolls to be charged for all traffic carried by said railway.

8487—October 15—Approving of plan, known as Part 1 of the Toronto Grade Separation, showing crossings of Dufferin, Dunn, Jamieson, Dowling, Sunnyside, and Howard Avenues and Indian Road in the western end of the city of Toronto, by the G.T.R.

8488—October 13—Rescinding Order No. 7488, dated July 9th, 1909, directing the G.T.R. to provide a night watchman at Wellington Street Crossing, Hamilton, Ont., by authorizing the G.T.R. on account of the small amount of traffic only to keep watchman on duty from 7 o'clock a.m. until 9 p.m.

8489—October 21—Directing that the maximum toll to be charged by the North American Telephone Company for any conversation not exceeding three minutes' duration, between village of Carp, and Ottawa, Ont., be reduced from twenty-five cents to twenty cents.

8490—October 19—Directing the C.N.Q.R. to construct and maintain a raceway and other openings under its track on its approved location at the Jacques Cartier River in the property of John Forman, Parish Les Ecureils, P.Q.

8491—October 26—Granting leave to the town of Claresholm, Alta., to erect, place, and maintain its wires over the track of the Calgary & Edmonton Railway, where the same crosses Centre Avenue, Claresholm, Alta.

8492—October 26—Authorizing the G.T.R. to construct, maintain, and operate branch line to and into the premises of Gardiner Bros., Sarnia, Ont.

8493—October 6—Approving location of the G.T.P.R. through the city of Fort William, Ont.

8494—October 28—Approving and sanctioning location of G.T.P.R. Branch Lines Company, Melville-Yorkton Branch, mileage 18 to 25.3, district Assiniboia, Sask.

8495—October 29—Approving and sanctioning location of the C.N.R. Goose Lake Branch, mile 117.06 to 170.49, Saskatoon westerly.

8496—October 28—Approving stress sheets of the G.T.R. Company's proposed bridge over new subway for pedestrians at Convent, near Lachine, P.Q.

8497—October 29—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for Imperial Oil Company, Limited, Lethbridge, Alta.

8498—October 28—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for Western Planing Mills Company, city of Calgary, Alta.

8499—October 29—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for Western Canada Land & Live Stock Company, Fort William, near Neebing Station, Ont.

(Continued on page 539).

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## TREATMENT OF WATERS POLLUTED BY VEGETABLE GROWTHS.

Recently we had the question put to us: "Whether would you advise filtration or sterilization with a particular water?" It turned out that the particular water was entirely free from pathogenic bacteria; that, in fact the source (a small lake) was so situated that any chance of pathogenic contamination was out of the question.

The water, however, on analysis showed an excess of organic matter, the result of vegetable growths. The taste and odor of the water was extremely disagreeable, while the color was decidedly brown. Turbidity, however, was practically nil, there being little or no suspended matter.

Waters of this character are commonly met with, and are generally associated with ponds or small lakes surrounded with growth, in which the water is not subject to rapid change as between inlet and outlet.

Collected water, the result of seepage from forest surfaces, or springs forming small lakes, where the water has to pass through deep layers of decaying vegetable growth, are all marked by the above objectionable characteristics. While such water is incapable of producing any specific disease, it forms a ready medium for the growth of disease germs if admitted.

The characteristic brown color of the water is due to tannin; this also gives the astringent taste. The disagreeable odor and taste are the results of the decomposition of the vegetable growth.

Allen Hazen in "Filtration of Public Water Supplies," page 112, states: "In the removal of tastes and odors from pond or reservoir waters which are not muddy, but which are subject to the growths of low forms of plants, which either by their growth or decomposition impart to the water disagreeable tastes and odors, intermittent filtration may have a distinct advantage. In such cases there is often an excess of organic matter to be disposed of by oxidation."

The correct reply to the question asked of us is neither filtration in the ordinary meaning of the term, nor sterilization.

Filtration, in the sense of straining, is quite unnecessary, as there is practically no suspended matter requiring removal. Sterilization, in the sense of destroying disease germs, is also quite unnecessary, as there are no disease germs to destroy. The treatment required consists of:—

(a) Aeration to remove the gases of decomposition absorbed by the water.

(b) Contact with some material which will absorb the color.

(c) Nitrification and oxidation, in order to reduce the excess of dissolved organic matter.

The processes, (a), (b), and (c), can be accomplished effectually and cheaply in a combined plant consisting, first, of a method of spraying the water over the surface of a filter constructed not of sand for straining purposes, but of rough material of about ½-inch broken stone, with a top layer of about 1 ft. 6 in. of charcoal. Spraying the water will liberate the gases. The charcoal will reduce the color due to tannin, while the rough filtering material will provide a nitrifying bed, similar to that used for purification of sewage.

If the above process be carried out with proper attention given to the relation between the volume of water treated and the amount of nitrifying material, complete success can be obtained, even with very highly algæ-polluted waters.

The important point to observe in connection with the nitrifying bed is that of efficient underdrainage, and further, that the water is never delivered at a rate sufficient to saturate the material, but only at a rate allowing the water to dribble through the material in contact with air in its passage.

We have endeavored to answer the above question fully, as there appears to be a tendency at present to pay particular attention to the respective merits of sand filtration and sterilization without reference to other processes, which are just as important with certain classes of water.

Sand filtration and filtration followed by sterilization may be necessary with many classes of water contaminated with sewage when the object is the removal of disease germs. In Canada, however, we have to depend upon many sources of supply, which cannot possibly be contaminated with sewage, but, on the other hand, are charged with objectionable matter, the removal of which does not depend upon either sand filtration or sterilization.

## SOME NOTES ON THE SEPARATION OF SOLIDS FROM SEWAGE AND WASTE LIQUORS.*

By James P. Norrington.

In the fifth report of the Royal Commission on Sewage Disposal it is clearly demonstrated that of all the processes for the treatment of sewage which are commonly in use to-day that which costs the least in upkeep has for its preliminary process quiescent settlement without chemicals. On the other hand, the initial cost of the tanks required is higher than all but one of the five preliminary processes compared in the report. The area of filter required, however, to follow the preliminary quiescent settlement tanks is found, as a rule, to be considerably less than with most

* Read before the Association of Municipal and County Engineers, England.

of the other processes; in other words, the greater the percentage of suspended solids removed, the larger is the volume of sewage that can be treated on the same area of filter; in fact, throughout the report the elimination of the suspended matter from sewage before allowing the flow to pass on to the filters or into a stream, or by way of storm water overflow, is considered a matter of the highest importance. Any means, therefore, which can be successfully and economically adopted for the removal of the suspended matter are well worth our consideration; if, at the same time, they facilitate the handling of the solid matter or sludge, that will also be of advantage.

The object of this paper is to bring before your notice one or two arrangements for attaining these ends which are being successfully worked on the continent and in this country.

The first of these, like many other good as well as indifferent things, comes from Germany, and is known there as the Kessel, the name probably being derived from the boiler-like shape of the apparatus. Its main feature is a vertical cylinder with an inverted cone-shaped bottom, and a cone-shaped or domed top. This is fixed on wrought-iron or brick supports above the level of the flow of sewage to be treated. The apparatus is so arranged that the flow is syphoned through this cylinder with a loss of two or three inches only in the level of the sewer. This is effected as follows:—

A manhole, or chamber, is constructed at the point on the sewer from which the sewage is taken, the floor of which is a foot or more below the invert of the sewer at this point. Into this the short leg of the syphon is brought and finishes below the invert of the sewer, so that it is always trapped.

On the opposite side of the Kessel a corresponding manhole or chamber is provided to receive the long leg of the syphon, which is trapped in a similar manner.

The invert of the outfall from this second chamber is kept two or three inches below the invert of the sewer as it enters the first manhole to ensure syphonic action.

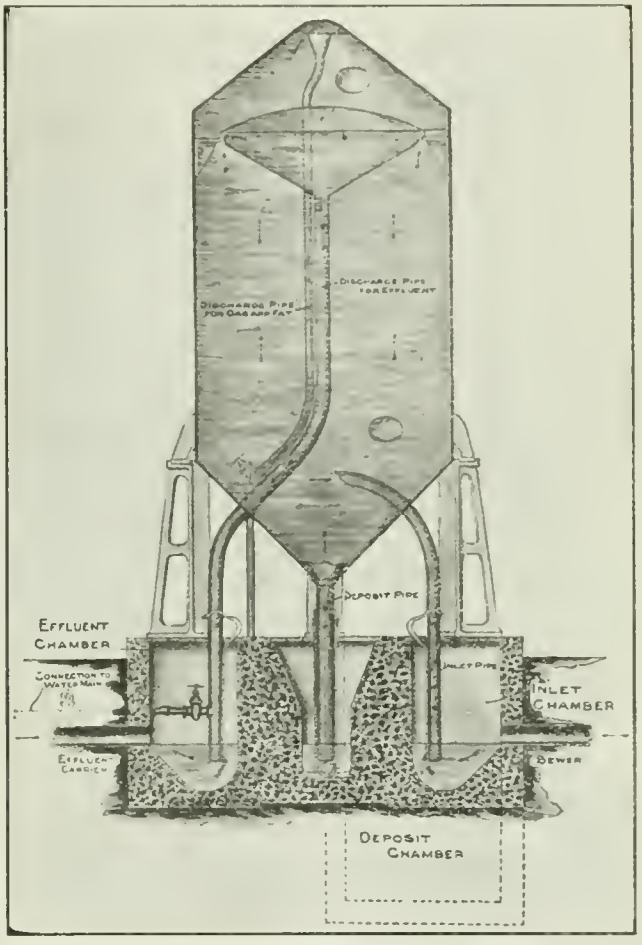
Directly below the Kessel a third chamber is provided, and into this a third pipe or leg (known as the deposit pipe), is brought from the bottom of the cone. This also is arranged so that the foot of the pipe or leg is trapped.

Reference to the accompanying diagram will make this clear, and it will be seen that the short leg of the syphon, or inlet pipe, as it is called in the diagram, passes through the cone-shaped bottom of the Kessel and finishes inside same immediately over the centre of the inverted cone, the end of the pipe being shaped so as to deflect the heavier solids in that direction. The long leg of the syphon, or discharge pipe for effluent, is also carried through the cone-shaped bottom of the Kessel up the centre of same to near the top of the cylindrical portion, where it finishes in a covered inverted cone, the greatest diameter of which approximates the internal diameter of the cylinder of the Kessel. The inlet to this cone is through a narrow slot extending the whole circumference of same, immediately below the cover. You will also notice in the diagram that there is a fourth pipe marked "Discharge pipe for gas and fat," which passes through the cone-shaped bottom, and finishes with a small cone-shaped mouth directly below the centre of the cone or dome-shaped top.

For easier manipulation all four of these pipes are fitted with valves. To ensure syphonic action through the Kessel it is necessary to first fill it with water, and for this purpose a connection to the water main is provided to one or other of the before-mentioned legs. In the diagram this is shown connected with the discharge pipe for effluent, or long leg of the syphon.

The action of the apparatus is as follows:—

The large cylinder or Kessel having first been filled with water, and the three chambers into which the legs of the syphons are conducted filled sufficiently to trap the legs, and the valves in the legs opened, syphonic action at once commences, and the sewage finding its way into the inlet chamber passes up into the Kessel. The shape of the inlet pipe, as before mentioned, deflects the solids in suspension towards the bottom of the inverted cone, and the coarser and heavier solids at once find their way through the deposit pipe into the centre chamber; the lighter solids, on the other hand, rise to the top of the Kessel, while the liquid, still carrying a large proportion of fine solids in suspension, commences to gradually rise in the Kessel. These finer solids are gradually dropped during the slow upward rise




**The Kessel.**

of the sewage in the large cylinder or Kessel, and before the level of the outlet connected to the long arm or discharge pipe is reached, practically all the solids in suspension have been left behind, and the effluent leaving by the discharge pipe is quite free therefrom.

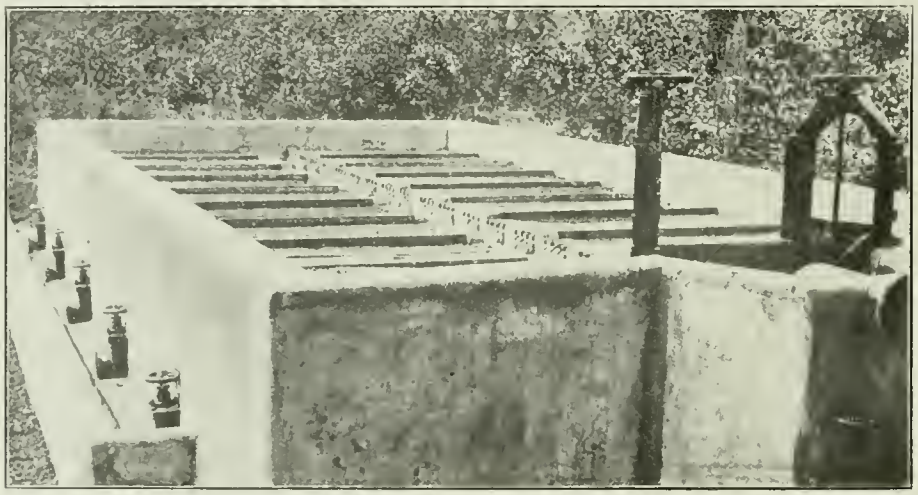
The heavier solids on reaching the bottom of the Kessel are diverted by the inverted cone-shaped bottom thereof to the central or deposit pipe, and through this into the chamber. This latter may be extended to a size sufficient to hold any desired quantity of solids. It is a curious fact that as this chamber fills with the solids, the liquid portion of the contents passes out through the same pipe by which the solids enter; consequently this chamber may be worked until the percentage of liquid left is sufficiently small to enable the solid contents to be handled with comparative ease.

The section of the suspended solids which have a less specific gravity than water accumulate on the underside of the dome cover of the Kessel, and are easily withdrawn therefrom by opening the discharge pipe for gas and fat, closing the valves in the three syphon legs and turning on the water supply.

The liquid portion, freed from solids in suspension, passes off through the effluent carrier either to filters or land. The rate of discharge through the effluent carrier is in exact proportion to the flow entering the inlet chamber. With some sewages the treatment by the Kessel is sufficient to admit of its being passed direct into a stream.

The author is also of opinion that it is desirable to treat in a similar manner all sewage where it is now discharged in a crude state into the sea, as it is scarcely possible to find any important seaside resort without a sewage outfall far too close to the beach set apart for bathing.

The quantity which can be treated depends upon the size of the Kessel used and the nature of the sewage, and will vary from a flow, which will produce an upward motion over the whole sectional area of the Kessel or cylinder of



**Separator Treating 30,000 Gallons per Hour. Outside Dimensions 33 ft. by 18 ft.**

half to one millimetre per second, or, put into English measure, from 1¼ to 2½ inches per minute.

To give an example of the size required, a Kessel with a diameter of eight feet would deal with from 2,000 to 4,000 gallons per hour; a diameter of 30 feet, 25,000 to 50,000 gallons per hour. The height is, of course, limited by the atmospheric pressure as compared with specific gravity of the liquid dealt with; that is, from 27 to 30 feet. Putting the size of the Kessel in terms of the flow to be treated, it should hold from 1½ to 3 hours' flow.

With regard to the results produced by this class of installation, analyses show that with waste from a paper factory, 75 to 90 per cent. of suspended matter was eliminated according to the rate of flow, whereas with slaughter-house refuse as much as 99.7 of the solids in suspension and 99 % of fat is removed.

With an ordinary domestic sewage about 70 per cent. of the solids in suspension were removed.

These results compare very favorably with those given in the Royal Commission Report previously referred to. The best examples given of results from treatment by sedimentation tanks show a removal of about 50 per cent. of the suspended solids from tanks which hold as much as [illegible] to 15 hours' flow.

The second type of separator consists in its essential features of a shallow tank, the capacity of the grit chamber being sufficient to steady the flow of sewage and admit of the grosser and heavier solids sinking and the lighter solids rising. The exit from the grit chamber to the shallow tank following it is kept well below the surface, and the flow passing forward contains only the more finely divided solids in suspension, the specific gravity of 99 per cent. of which will be found to be slightly in excess of water in almost all sewages.

In the somewhat larger area of the tank these finer solids sink to the bottom if the outlet from the tank is arranged so as to avoid any movement in the liquid, the velocity of which is sufficient to carry the finely divided solids forward with it. To put it in other or more familiar words, there must be no movement in the tank with what we should call in a sewer a "self-cleansing velocity."

The method by which this is attained in the separator now under consideration is by dividing the flow from the tank over the edges of a large number of small channels placed on the surface, all of which are set truly level the one with the other. The flow is thus divided over what may technically be said to be a very long length of weir. The velocity of the approach to the weir is so low that even the finely divided solids are left behind if their specific gravity is the least in excess of water.

In larger plants the shallow tank is divided into sections for the better regulation of the flow through same. (Plate No. 2 shows a separator of this class, capable of dealing with 30,000 gallons per hour of ordinary sewage.) Both the grit chambers and the shallow tanks are fitted with floors and draw-off pipes especially designed for the easy removal of the solids.

For continuous work this type of separator should be arranged in duplicate like that shown in the view, so that one half may be cleared of solids while the other is in action; one section should be cleared daily.

The tanks and grit chambers are both fitted with arrangements for drawing off as much as possible of the supernatant water before the solids are withdrawn.

The total capacity of an effective plant of this type may be kept down as low as half-an-hour's flow of the maximum volume to be dealt with, and such capacity divided into the two sections above referred to.

Some remarkable results have been obtained with a plant of this type at Dorchester, where at least 25 per cent. of the total volume of the sewage is brewery refuse. The proportion of suspended solids removed from the crude sewage in this manner is as high as 96.5 per cent., and at

the same time the purification effected on the albumenoid ammonia figure is 74 per cent., and on the oxygen consumed from 89.9 per cent., and that without filtration of any description.

Such results compare very favorably with those produced by many complete installations of tanks and filters. If equally good results can be obtained from a weak or dilute sewage, it appears to me that subsequent filtration or treatment of any kind is entirely superfluous.

Another very considerable advantage, especially in small town installations, is that this type of plant enables the solids or sludge to be dealt with day by day instead of allowing it to accumulate until the volume is so great that to deal with it entails the employment of a considerable amount of extra labor. Taking it day by day, a single caretaker at a small town installation can easily do all that is necessary.

It appears to the author that a type of plant which produces such results could certainly be modified to effect the purification of drinking water; at any rate, it would remove the suspended solids which give us so much trouble in the effluents from many sewage filters.

The principle involved in both these types of separators is, that after the water has done its work of transporting the polluting solids from the house to the spot where they can be dealt with, the sooner it is separated from the sewage solids the better. This is especially so in districts such as this, where, as a rule, the water supply is from chalk, and consequently hard. The amount of dissolved impurities taken up in solution by the water used for conveying the sewage will be very small with a plant of this sort, through which the whole flow passes in less than an hour, compared with a sedimentation or septic tank, the capacity of which varies from 15 to 30 hours' flow.

Another point which strongly appeals to the author is that the manurial value of the solids separated is correspondingly increased, as it has always appeared to him that the septic treatment of sewage has actually destroyed material that could far more usefully be used on the land.

Before my paper is discussed, I should like to add one or two further remarks as to the saving effected in the cost of sewage plants by "the separator" in lieu of ordinary sedimentation or septic tanks. A comparatively simple plant, with a capacity of from a half to three hours' flow of sewage, must, in the nature of things, cost considerably less than tanks holding from 15 to 30 hours' flow. Even making allowance for the additional fittings required, at least 50 per cent. of the cost of tanks would be saved in this respect alone.

Another important consideration is the comparatively small filter capacity required, and a saving may be expected on this head of 25 per cent. compared with that necessary to follow septic tanks, for example.

Taking one with the other, we may reckon that a saving of at least 30 per cent. on the whole cost of an installation might fairly be expected, and this without impairing its efficiency; but, on the other hand, rather increasing it.

Such a saving is of the first importance in any case. If, for example, the authorities of this ancient city were installing a new plant for the treatment of their sewage, it would be a saving of at least three to four thousand pounds.

At the present moment there are none of the Kessel pattern in use in England, but I have one or two photographs of German plants which will doubtless be of interest. The nearest plant of any size of the other type referred to in the paper, namely, that at Dorchester, is no doubt familiar to some of our members. In this case the addition of a "separator" rendered it possible to treat without nuisance a sewage much polluted with brewery refuse, and without otherwise enlarging the existing plant, which had hitherto been found wanting. This is an illustration of another way in which a plant of this kind may be introduced, namely, to increase the capabilities of an existing plant. With ordinary domestic sewage, the addition of either a separator or a Kessel will enable an efficient existing plant to deal with an increased volume of at least 30 per cent., and either of them occupy such a small space that there would always be room for it without purchasing additional land; a great advantage in many cases. Another use of the separator, which I have not referred to in the paper, is for sea outfalls. Either type of plant, that is, either the Kessel or the separator, would be quite sufficient without either tanks or filters, as they effectually prevent any suspended solids from going forward with the flow.

Many of you must be aware of the objectionable features that one comes across at seaside places where they are discharging crude sewage into the sea, and no doubt numerous cases of typhoid fever take place from that cause. I think that ought to be avoided.

## SOME COMMENTS ON ASPHALTIC SPECIFICATIONS.

H. Tipper.*

The increasing use of asphalt and the entry into the field of a large number of producers of asphaltic, and other bituminous materials for road building, has added a great deal to the already confused state of the specifications governing this class of work. The specifications for asphalt in the paving industry, have commonly been burdened with too much description and have had too little relation to the actual requirements which would be of value in a pavement. It has been usual for each producer to issue his own specifications, primarily a description of his own material, and not necessarily a standard of quality. The result has been that the paving industry has been burdened always with tests and specifications which are not of value as a means of determining a desirable material, and which cannot be so translated. The enginering features of the situation have commonly been neglected and the specifications based upon imperial tests which have little or no value. The situation in the last few years instead of improving, has rather (with a number of additional producers in the field embracing both liquid and solid bituminous materials), become confusion worse confounded. It is evident from a very casual perusal of the different specifications issued by different producers and partially or wholly adopted by engineers, for the application of bituminous materials to roads, that the views held by different interests as to the desirable material to be used for road building purposes, are entirely divergent, and in a great many cases, absolutely contradictory. The fact is really stated most efficiently, when it is admitted that we know little or nothing about bituminous materials and the characteristics which affect their value for road building purposes. Nevertheless, we are not afraid to issue long and complicated specifications with equally complicated tests for the purpose of indicating the value of a material of which we know very little, and of the effect of which in a road we know hardly any more.

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A number of these tests can be cited as illustrations of the absurdity of the present method of specifying, the necessity for a reasonable amount of investigation, and a determination to drop out of the specifications, all tests which canno show at least a reasonable relation to road building value.

It has been customary to refer to asphalt as either natural asphalt or oil asphalt. Since both asphalts which are found in deposit, and asphalts which are manufactured from the crude petroleum, are originally, (according to present theories), formed by the reduction of the oil, there would seem to be no reason for differentiating between the two, except that the asphalts which are taken from deposits have been reduced with the variations always to be found in any deposit, and are consequently not of uniform value. Whereas, the asphalt produced from the crude asphaltic petroleum can be manipulated scientifically so as to provide a uniform material in which the variations are so slight as to be negligible. To attempt, however, to say that because an asphalt has been mined or taken from a deposit, it is superior to a material manufactured from the crude petroleum, is an evident absurdity. It has always been found possible by scientific manufacture, to produce from the raw materials, a better, more uniform and more valuable product, than is possible when it is produced in the haphazard fashion of nature.

It is no uncommon thing to find in specifications for asphaltic binders for macadam road work, a reference to the percentage of dirt, etc., which will be allowed in the material, and a further percentage allowance for material not soluble in carbon bi-sulphide. Inasmuch as carbon bi-sulphide is the only solvent at present in use for extracting the bitumen from any compound, it is evident that one statement as to the allowable insoluble matter, whether dirt or anything else, would sufficiently answer the purpose and prevent the confusion which is bound to occur in the consideration of two such contradictory tests.

A high flash point and an evaporation test in which a very small percentage of material is to be allowed to evaporate at a certain temperature, (frequently 325 or 500°) when subjected to a high temperature for a period of several hours, is frequently required in specifying a binder for macadam road. The absurdity of this is readily seen when it is understood that all materials for use with macadam roads, are either liquid or semi-liquid bituminous materials, and are consequently in their initial state too soft to prove valuable binding materials, the object being to produce a material which will mix with the cold stone and afterwards change its consistency so as to set up to the proper hardness of the road. If the material, however, is a semi-liquid and will not evaporate under a high temperature for several hours, it is evident that it will not set up rapidly to the proper degree of hardness on a road under ordinary atmospheric temperatures.

In a paving cement where it is necessary that the material should not change its consistency an evaporation test of the kind mentioned, is a valuable indication of the unchangeable character of the material. In a binder for macadam road, however, the test is unnecessary and contrary to the requirements. The fact of the matter is that the residual oils while they may be reduced from the crude asphaltic petroleum, are loaded up with a heavy end consisting of tarry residues and heavy lubricants so that they contain a comparatively small percentage of the true asphalt for their body. In addition to this, the lubricants are distinctly a detriment to the necessary adhesive quality of the binder, and will not hold the stone of the road together with the same degree of strength as the materials which are made so that they are not loaded up with a heavy end.

Further tests which are frequently specified, such as the flow test and the viscosity test where these state a maximum and minimum viscosity, are evidently made without any real investigation of the subject and any proper consideration of the qualities which are necessary in a bituminous binder for macadam roads.

All these ill-considered tests and specifications which do not show the value of the material in relation to road building, and are frequently contrary to the considerations involved, are merely a burden and do not allow of the engineer securing the best possible material. When it is evident that we know little about these values, the purpose would seem to be best served by admitting as much and not by specifying where the value is not ascertained. Comparatively little attention has been paid to this subject of bituminous binders for macadam road work until the last few years, and in the absence of any knowledge on the subject, it seems to have been customary to take the specifications issued by producers of different materials and use them as a basis when their value is still to be discovered.

The same thing is true in a lesser degree in the specifying of asphalt for paving purposes. It has been customary, and is still customary, in a good many cities, to specify the refined asphalt and the flux, frequently specifying the origin of these materials, when as every engineer knows, the material which enters into the pavement and which it is really valuable and necessary to test, is the asphaltic cement which may, or may not be made with asphalt and flux as it can be made at the proper consistency without the use of flux if it is scientifically manufactured from the crude petroleum.

The introduction into asphaltic specifications, particularly for binder macadam roads, of tests which have no translatable relation to road value, and which cannot be supported on assumptions other than the merest theory, has made an investigation of the practical requirements necessary. The question is one of elimination rather than of anything else, and by consideration of the tests demanded in various specifications, it appears that for the most part they are either unnecessary or of little value.

After the elimination of the unnecessary specifications and the consideration of the proposition from a practical standpoint, the following specifications together with the qualities which they are intended to define, were suggested by Dr. Albert Sommer, in the early part of this year, and are given here as an attempt to reduce the specifications for asphaltic binders for Macadam road building to only such requirements as can at present be considered as of value in the practical construction of macadam roads.

Further discussion of these will doubtless be necessary, and it is invited in the hope that such discussion will result finally in some agreement as to the necessary qualities in an asphaltic binder and the elimination of much in the present specifications which is of dubious value:

(A) It shall contain as much as possible of asphalt of suitable consistency for building the road.

(B) It shall be as fluid as possible in order to enable it to be properly applied by the method proposed.

(C) For this reason all products must be eliminated "a priori" which would increase the viscosity without increasing the percentage of asphalt.

(D) A compound, therefore, must be chosen which has been made from a solid asphalt by using a rather light flux. The flux shall contain no lubricating or paraffine oils and shall be used only as a carrier. It should either evaporate or seep into the stone or mineral aggregate upon application, thus making the compound set up rapidly after it is on the road.

That cold stone will be applied in most cases seems to be a foregone conclusion. For this reason a solid asphalt will in most cases be out of the question. No matter, however, what mixing methods should be finally decided upon, at any rate a satisfactory asphaltic material must comply with the above requirements.

As to specifications which are in accordance with the above suggestions, the following is a sample:—

**A Specification Proposed for a Macadam Binder of 80 Per Cent. Asphaltic Contents.**

(1) It shall be soluble in bisulphide of carbon to not less than 99.5 per cent.

(2) It shall be soluble in carbon tetrachloride to not less than 99.5 per cent. (Solubility in tetrachloride indicates absence of so-called "carbenes" which are always an indication that the asphalt has been overheated).

(3) When heated to a temperature not exceeding 500° F. until 20 per cent. are evaporated, the residuum shall have a penetration of not more than 10 mm. when tested with a No. 2 needle, weighted with 100 grs. at 77° F. on the Dow machine.

(4) The compound shall be sufficiently liquid at working temperatures so that when tested in an Engler viscosimeter at 212° F., 50 cubic centimeters shall not take more than 200 seconds to flow out.

(5) The solid contents of this material should consist only of asphalt and the consistency of the residue shall not be due to any other solid substance, such as paraffine. The paraffine scale of the total compound shall not exceed 1 per cent. Paraffine scale is to be determined by destructive distillation of the entire compound to coke, and determination of the paraffine scale in the distillate by the Holde method.

(6) The asphaltic binder shall not contain any dirt or water, but shall consist of pure bitumen only. Tar or substances recovered from acid sludge shall not be admitted.

## RAILWAY ORDERS.

(Continued from page 533).

8500—October 29—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for Muirhead & Company, Fort William, Ont.

8501—October 26—Granting leave to the British Columbia Electric Railway Company, Limited, to erect, place, and maintain its wires across right of way of the C.P.R., north end of Cambie Street, Vancouver, B.C.

8502—October 13—Authorizing the corporation of the village of Glencoe, Ont., to erect, place, and maintain the electric light wires of the Glencoe Municipal Electric Lighting Plant across the track of the G.T.R. on Main Street in said village.

8503—October 26—Granting leave to the Shawinigan Water & Power Company to change the location of its line at a point where it now crosses the St. Maurice Valley Railway near Three Rivers, P.Q.

8504—October 19—Directing that upon the installation of new telephone system by the Bell Telephone Company in the Russell House, Ottawa, Ont., a charge of ten cents for each connection from such system with the Ottawa Exchange subscribers be charged.

8505—October 28—Approving Passenger Tariff, C.R.C., No. 1, of the Montreal & Southern Counties Railway.

8506—October 29—Authorizing the corporation of the city of Peterborough, Ont., to lay and thereafter maintain water main under the track of the Lakefield branch of the G.T.R. at Antrim Street, said city.

8507—October 28—Authorizing Kate S. Massiah, of St. Jerome, P.Q., to lay and thereafter maintain water pipe under the track of the C.N.Q. Railway one mile east of Lachute, P.Q.

8508—October 29—Extending the time within which the Grand Trunk Railway Company, (until November 10th, 1909), may appeal to the Supreme Court of Canada from Order No. 7613 of the Board, directing that said railway provide station accommodation at or near the point where the company's line from the city of Hamilton to Niagara Falls cross townline between Townships Clinton and Louth, Ont.

8509—October 28—Authorizing the C.P.R. to construct, maintain, and operate industrial spur to the flour mills of Messrs. Pfeffer Bros., Milverton, Ont.

8510—October 27—Granting leave to the Parish of Notre Dame du Lac, P.Q., to construct a highway across the tracks of the Temiscouata Railway Company to connect with road in the village to the Government wharf.

8511—October 30—Approving change in location of the C.P.R. Company's station at Bissett, Ont.

8512—November 2—Approving Standard Passenger Tariff C.R.C. No. 10, of G.T.P. Railway, cancelling Standard Passenger Tariff C.R.C. No. 2.

8513—October 16—Directing that the rate charged by the G.T.R. for moving grain in car load from the company's elevator at Point Edward to the King Milling Company's mill at Sarnia, be reduced to one and a half cents per hundred pounds.

8514—November 2—Amending Order No. 8239, giving the C.N.R. permission to cross with its tracks the tracks of the G.T.P. Railway at or near Riley, Alta., by substituting for the word "principal" where it occurs in the 15th line of the recital, and the fourth line of clause 1 of said Order, the word "Fourth."

8515—November 2—Authorizing the G.T.P. Railway and the Edmonton & Slave Lake Railway Company to operate their trains over crossing at Section 15, Township 53, Range 25, west 4th Meridian, district Edmonton, Alta., without being brought to a stop.

8516—November 2—Recommending to the Governor-in-Council for sanction by-law No. 7 of the Brandon and Saskatchewan Railway Company re spitting in cars and on railway premises.

8517—October 27—Directing the C.P.R. to protect crossing of Main Street by a watchman between the hours of six o'clock a.m., and 7 o'clock p.m., daily, at Farnham, P.Q.

8518—October 29—Authorizing the C.P.R. to construct, maintain, and operate branch line for ballast purposes from its main line in the N.W. ¼ Sec. 2, Tp. 13, R. 3, west principal meridian, Manitoba.

8519—October 29—Approving and sanctioning deviation in location of C.P.R. Company's Motherlode Branch, B.C.

8520—October 29—Approving and sanctioning location of G.T.P. Railway Company's line from mileage 289 to mileage 347.346, Willow River, Cariboo District, B.C.

8521—October 29—Approving and sanctioning change of location of the C.P.R. Company's main line from mileage 95.60 to mileage 132.18 from McLeod, B.C.

8522—October 22—Granting leave to the National Transcontinental Railway to construct undercrossing, under public crossing, 2 miles easterly from Quebec Bridge.

8523—October 29—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the track of the G.T.R. at public crossing two and one-half miles east of Gervais, Man.

(Continued on page 541).

## PROBLEMS IN APPLIED STATICS.

T. R. London, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

**Find the stress in the remaining members LG, GB, EF, and FG.**

These stresses may be found by first considering the point BPLG, and then the point GLDEF.

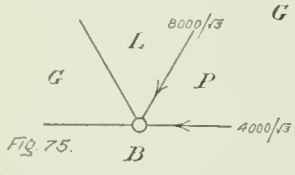


Fig. 75.

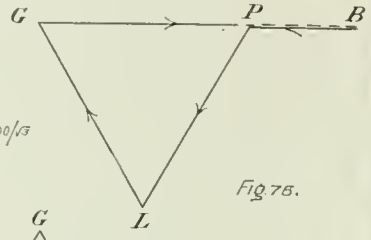


Fig. 76.

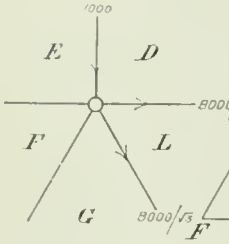


Fig. 77.

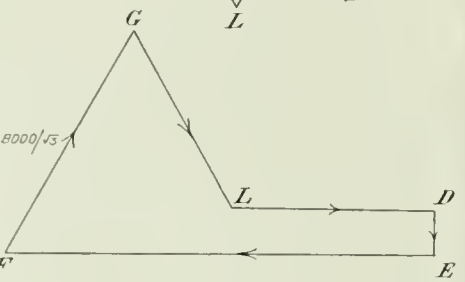


Fig. 78.

Fig. 75 represents the condition at the point BPLG, In drawing the Vector Polygon for this point it is found that the line GB (Fig. 76) coincides for part of its length with the line BP already drawn. In order to help the reader, the portion of GB which would coincide with BP has been shown by a dotted line. The diagram reads:

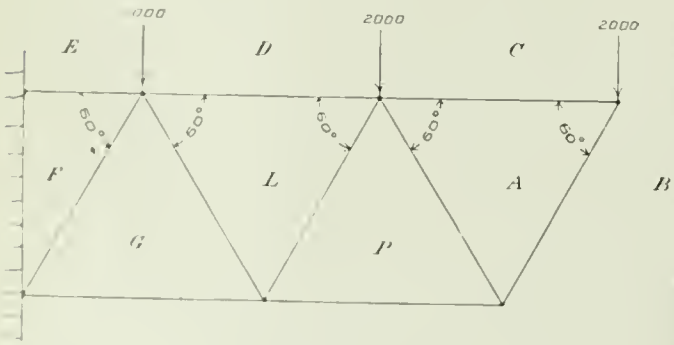


Fig. 67.

BP, PL, LG, and GB. From this it is seen that the member LG is in tension $8{,}000/\sqrt{3}$ pounds and the member GB in compression $12{,}000/\sqrt{3}$ pounds.

Figs. 77 and 78 are, respectively, the Statical Diagram and Vector Polygon for the point GLDEF. The member EF is in tension $17{,}000/\sqrt{3}$ pounds and the member FG in compression $10{,}000\sqrt{/3}$ pounds.

**To Construct a Stress Diagram.**

In the last problem a new Vector Polygon was constructed for each set of forces being considered. If these diagrams are drawn to a suitable working scale, they spread over a considerable area, and also, in transferring magnitudes to a new line, there is the liability of an error which may or may not be cumulative in its effect throughout the problem. It is possible, however, to condense these diagrams and at the same time restrict the liability to error in magnitudes by drawing what the writer chooses to call a **Continuous Vector Diagram**, or, as it is often referred to, a **Stress Diagram.**

It may be pointed out that it will help to simplify the problem if the reader will construct, on a loose sheet of paper, the Vector Polygons (Figs. 69, 71, 73, 76, and 78), using the same scale of forces in each case. These polygons may then be referred to in drawing the following diagram. The reader must bear in mind that **the same scale of forces will be used throughout the following problem:—**

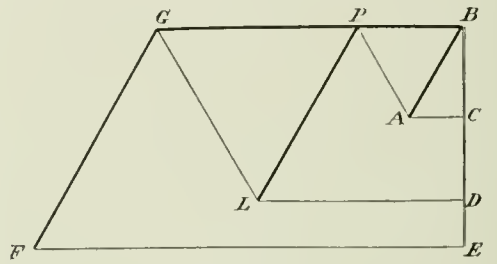


**Fig. 79.**

Considering the Statical Diagram (Fig. 68), it is seen that the triangle BCA (Fig. 79) may be taken as a Vector Polygon for the forces acting at the point BCA of the truss (Fig. 67). Instead of placing sense marks on this polygon to indicate how the forces act, a thin line is used to represent that the force CA is a tensile force, a thick line to indicate that the force AB is a compressive force, and a double thin line to denote that the force BC is due to a load. This system of representing tensile and compressive forces and loads will be adhered to throughout the problem.

Taking next the point BAP, it is seen from the Statical Diagram (Fig. 70) that the force BA is a compressive force. Referring to Fig. 79, it is found that there is already drawn a line which may represent this compressive force, provided the letters at the extremities of this line be read the proper way to correspond with the sense of the force as shown on the Statical Diagram; namely, the thick line BA. The lines AP and PB complete the Vector Polygon for this point. AP, being a tensile force, is represented by a thin line, and PB, being a compressive force, by a thick line.

Acting at the point PACDL are three known forces, PA, AC, and CD, as shown in the Statical Diagram (Fig. 72). It is seen that the thin lines PA and AC (Fig. 79) are so constructed that they may represent the tensile forces PA and AC. From C (Fig. 79) is drawn a double line CD to represent the force CD due to the load. The lines DL and LP represent, respectively, the unknown forces DL and LP. If sense marks were placed on the diagram, DL and LP would be found to be tensile and compressive forces, respectively, as indicated by the thin and thick lines. The diagram for this point reads PA, AC, CD, DL, and LP.

From the Statical Diagram for the point BPLG (Fig. 75) it is seen that the two forces BP and PL are compressive forces. They may, therefore, be represented by the thick lines BP and PL (Fig. 79) since these lines

are properly constructed to represent their magnitudes and directions. The Vector Polygon for the point is completed by the lines LG and GB, the diagram reading BP, PL, LG, and GB.

The reader is advised to construct the remainder of the diagram for the point GLDEF for himself. The diagram when drawn should read, GL, LD, DE, EF, and FG.

Doubtless, the reader will see that the construction of this Stress Diagram is merely a process of piecing together the Vector Polygons for the various points of the truss.

It should be noticed that the lines of the Stress Diagram, since they have no sense marks placed on them, really represent the magnitude of the stress in the various members; e.g., the line LG represents the stress in the member LG.

## RAILWAY ORDERS.

(Continued from page 539).

8524—October 29—Granting leave to the Consolidated Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. about two miles north of Inglewood Junction, Ont.

8525 and 8526—October 29—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at public crossing on North Street, Sault Ste. Marie, Ont., and near Bennington Station, Ont.

8527—October 29—Authorizing the corporation of the city of Ottawa, to lay and thereafter maintain tile pipe sewer under the track of the O. & N. Y. Railway on Gladstone Avenue, Ottawa, Ont.

8528—October 29—Authorizing the municipality of the town of Maple Creek, Saskatchewan, to maintain a sewer pipe under the track of the C.P.R. in sail town of Maple Creek, Sask.

8529—October 29—Granting leave to the C.P.R. to construct plank highway crossing at station 2880.16, mile 54.5 on Brandon section of its main line of railway.

8530—November 2—Directing the C.P.R. to provide and construct a suitable highway crossing where the company's railway crosses the extension northerly of Simpson Street, Sault Ste. Marie, Ont.

8531 and 8532 October 20—Granting leave to the corporation of the city of Fort William, Ont., to cross with a single track the track of the Mount McKay & Kakabeka Falls Railway at Yonge Street until May 1st next, in Fort William, Ont. That said crossing be protected by watchman day and night.

8533—October 22—Dismissing application of the city of Calgary for the construction of subways carrying 14th St. W., and 11th St. W., under the tracks of the C.P.R.

8534—October 22—Dismissing application of the residents of Bowell, Alta., for order directing the C.P.R. to establish station and permanent agent at Bowell, Alta.

8535—October 22—Determining the character of the work, and protection, at the crossing of the spur of the C.P.R. over the tracks of the Calgary Street Railway at Second Street East, Calgary, Alta.

8536—October 22—Directing that the city of Calgary and the C.P.R. Company construct a subway to carry First Avenue East under the tracks of the Railway Company at Calgary, Alta.

8537—October 22—Dismissing application of the C.P.R. for approval of location of station at Grassy Lake, Alta., and further directing that the C.P.R. submit new plans for station.

8538—November 2—Authorizing the Manitoulin & North Shore Railway Company to construct a bridge over Vermillion River, 18 miles west of Sudbury, Ont.

8539—November 3—Granting leave to the C.P.R. to open for the carriage of traffic portion of its line of railway known as the Lethbridge-Macleod Grade Revision, mile 0 to 31.4.

## MONTREAL STREET RAILWAY COMPANY REPORT FOR THE YEAR ENDED 30th SEPT., 1909.

The Montreal Street Railway, of which Hon. L. J. Forget is president, and W. G. Ross, managing-director, has an exclusive franchise to operate street railway in Montreal, Que., until 1922. They operate 138 miles of track. The population of Montreal is about 380,000.

The gross earnings increased during the year ending September 30th, 1909, $197,406.06, or 5.37 per cent., the operating expenses $96,625.11, or 4.48 per cent., the net earnings $100,780.95, or 6.63 per cent.

The gross earnings continue to show satisfactory increases. The per cent. of expenses to gross earning is 58.20 against 58.69 per cent. for the previous year.

The company again refuse to pay a portion of the city's accounts for snow removal, claiming the work was done in a wasteful manner. The snow fall according to the McGill University records were nearly two (2) feet less than the previous year, but notwithstanding this the city claims to have expended the sum of $208,435.75, an increase over the previous year of $5,901.37, and an increase over two years ago of $77,799.08, with 20.2 inches less snow fall. The increase in street mileage during this latter period was one mile, which at the average cost would only amount to $4,222.48.

The following statistical statement gives comparative figures since 1900.

It will be noticed that the car earnings per passenger decreases as the total number of passengers carried increased.

### STATISTICAL STATEMENT

| | 1909 | 1908 | 1904 | 1900 |
|---|---|---|---|---|
| Gross Earnings | $3,874,838.51 | $3,677,432.45 | $2,463,824.70 | $1,769,904.78 |
| Operating Expenses | 2,255,019.20 | 2,158,394.09 | 1,510,997.90 | 992,925.11 |
| Expenses % of Earnings | 58.20 | 58.69 | 62.37 | 56.34 |
| Net Earnings | 1,619,819.31 | 1,519,038.36 | 952,826.80 | 776,979.67 |
| Passengers Carried | 95,376,373 | 90,746,032 | 60,281,834 | 43,362,262 |
| Car Earnings per passenger | 3.96c. | 3.96c. | 4.00c. | 4.06c. |
| Transfers | 32,285,208 | 30,343,113 | 17,015,242 | 13,194,971 |
| Total passengers carried | 127,661,581 | 121,089,145 | 78,197,076 | 56,557,236 |
| Car Earnings per passenger total carried | 2.96c. | 2.97c. | 3.09c. | 3.12c. |

## LIGHTNING PROTECTION.*

By J. V. E. Titus, Second Vice-President Electric Service Supplies Company.

The term "lightning" is now used in a general way to describe surges of potential of a value high enough to approach the danger point. With this viewpoint lightning may be subdivided into two great branches, viz., internal, disturbances caused by switching, short circuits, grounds, etc.; and external, or more properly speaking, cloud lightning.

The most common phenomenon of external lightning is manifested as the induced static or "bound" charge, and that, by the way, is practically all that has to be contended with in low voltage circuits, such as railway lines. To illustrate, consider any overhead line insulated from ground; suppose a positively charged thunder cloud passes over it. The ground below the cloud assumes an electro-static charge opposite to that of the cloud above, as does also the line, and furthermore, the charge assumed by the line is higher than that of the ground, since it projects above it. A flash between cloud and cloud, or between cloud and ground, equalizes the potential existing between them, and requires a change of potential distribution on the line.

This equalization of potential between cloud and ground leaves a free charge on the line, which manifests itself now as an abrupt impulse or wave travelling along the line with the approximate velocity of light, 186,000 miles per second. These waves have frequencies corresponding to the discharge frequency of the cloud, and amount to thousands of cycles per second. Reaching an end of the line, they suffer reflexion either from resistance or otherwise, and give rise to complex phenomena.

On a line not connected to ground, some provision must be made to supply leakage for waves like these, otherwise the potential will rise until the insulation is punctured.

High e.m.f.'s are caused in a system by means of electro-magnetic induction, since the cloud discharge is a current, and sets up an opposing e.m.f. in any parallel conductor.

The phenomenon known as direct stroke perhaps occurs very infrequently on a system. In case the discharge does strike the line, it is quite possible that small damage to apparatus will result, owing to the choking effect of the line on such an abrupt discharge. The e.m.f. will on this account build up very suddenly, and probably jump to the pole and ground itself that way. Shattered insulators and splintered poles are the result. Supposing, however, that the discharge does take place near some apparatus, or that sufficient passes along the line to enter the station; in such cases protection will sometimes only be obtained at the loss of the arresters, which then certainly will have paid for themselves many times over.

The early lightning arresters, therefore, were crude affairs, and but few of the early ideas have survived. Originally, efficiency in discharging the circuit was the prime requisite, and the other essential to a successful lightning arrester, namely, durability, has come by a process of development.

A majority of the users of lightning arresters to-day do not realize that just about one-half of the efficiency and just about one-half of the durability depends upon the manufacturer and the lightning arrester itself, and the other half depends upon the user, in the way he installs it, and the care he takes of it after it is installed.

To-day the most progressive roads make it a practice to inspect lightning arresters at least three times per year, preferably in the spring, just before the first lightning storms occur, and while the earth is still moist with the winter rains; another inspection is made in mid-summer when the earth is dry, and at the time when the most severe storms usually occur. This inspection is probably the most important, as it enables one to find out whether the ground connection is as good as it should be after the surface of the earth has become thoroughly dry. The last inspection is made in the fall, after the storms are over for the season. At that time such arresters as have been damaged may be taken down and repaired or replaced.

Particularly at the spring inspection should the connections to rail be investigated. Frequently the connecting wires become frozen in the earth and the vibration of the rails breaks off the wires. Arresters having no visual means of operation are better tested by employing tell-tale papers —the size of the puncture serving in a measure to check up the condition of the arrester and the ground. By employing this plan of a series of inspections, the cost is kept down to a minimum, and the efficiency of the installation is properly maintained.

In installing lightning arresters, and particularly in the method of providing ground connections, there is a woeful lack of standard practice. Until the last year or two the ground connection has usually been made by burying a copper plate or coil in the earth, with which the ground side of the arrester is connected by means of a copper wire. As an original installation this makes an ideal connection, but such grounding has probably caused as many lightning arrester troubles as any other one element.

In most soils copper rapidly corrodes, and usually the resultant salts form a coating around the conductor that is practically an insulator, thereby introducing in the discharge path a high impedance. This not only impairs the discharging efficiency of the installation, but with some types of lightning arresters prevents the flow of sufficient current following the discharge to operate the circuit opening device.

The argument has been advanced that such resistance in a ground path is of but small importance, because such a ground connection being of large cross-section, offers a multitude of tiny paths or outlets over which the discharge will escape to earth. The fallacy of this argument is apparent when one considers the impedance that is offered a sudden rush of lightning by even a normal amount of resistance. It is quite as important that the ground path be of low ohmic resistance as that the lightning arrester itself should be. Any ground connection must discharge freely or the desired protection against very sudden rushes of lightning will not be secured.

The use of galvanized iron pipe for ground connections has been recommended for the last year or two with the very best results. In soils that will permit, the pipe may be driven to a sufficient depth to reach permanent moisture. This method of connecting lightning arresters by means of iron pipe insures the greatest possible durability at a reasonable first cost. Its chief advantage lies in the fact that iron pipe corrodes very slowly in practically all soils, and the resultant salts are fairly good conductors. Even after the pipe has completely wasted away the usual oxide provides a good conductor, unless, of course, it becomes broken. An effort should always be made to secure genuine iron pipe, and in its absence, the best grade of galvanized steel pipe.

* Abstract of paper presented as Appendix E, report of Committee on Power Distribution, American Street and Interurban Railway Engineering Association.

There are several reasons for a rail of the same static potential at all times. Great care is usually taken to have these conditions, but on many systems, particularly large interurban properties where rock ballast is used, the rail may be of other potential than the earth at many points.

Unless the rails and the ground are of the same potential there is every possibility of a discharge from the rail puncturing the windings of the motors of a car that is passing, and going to earth via the car, the trolley wire and the arrester on the adjacent pole. There has been advanced most unmistakable evidence that many car motors are burned out in exactly this way.

In choosing a system of lightning protection compromises have to be made. The air gap must be adjusted for some point between normal voltage of the system and what we may call the danger voltage at which the insulation of the system is imperiled. The first consideration, therefore, is that an arrester must have an air gap small enough to come between these limits.

A reason why the simple air gap is unsatisfactory as a lightning arrester is that on a grounded circuit every discharge will necessarily produce a dead short circuit between line and ground. This means not only a loss of energy, but severe and dangerous strains on the apparatus supplying the current. Something must be found that will limit the flow of dynamic current to such a degree that these severe strains and the resulting dangers are avoided, but in limiting this flow of dynamic current we must be careful not to limit or seriously impede the discharge of abnormal voltages.

To solve this problem, resistance, in series with the air-gap, at once suggests itself. The requisites, then, of a satisfactory lightning arrester appear to be:—

(1) A medium, such as an air-gap, which breaks down on a voltage low enough to insure protection to apparatus.

(2) A resistance of a value sufficient to prevent grounding and the consequent strains on apparatus, but not so high as to impede to any appreciable extent the free passage of the more heavy discharges.

(3) Some positive automatic means of interrupting the relatively small flow of normal current following the discharge.

Users are heard even to-day expressing the opinion that a lightning arrester is good for but one discharge. If that were true, then a fuse in series with an air-gap would be the ideal arrester, because it would be entirely efficient for its one discharge, and would be inexpensive. Results, however, have proven quite differently with the more modern types of lightning arresters now on the market.

A large part of the failures of the older forms of lightning arresters, employing a low series resistance and some form of circuit-opening device, was due to an increase of resistance of the resistance rod itself. These rods were usually made of some combination of carbon or graphite with kaolin. Due to the action of the discharge in some cases, and to an apparent ageing process in others, these rods kept on increasing their resistance while in service.

There are resistance rods on the market to-day, however, that entirely overcome this trouble, as after four years' service absolutely no increase of resistance is shown. These rods are composed of a combination of a special grade of carborundum, kaolin, and a high percentage of metallic conducting material, properly fluxed at an extremely high degree of heat in the firing kilns.

Modern arresters are so designed that the discharge has practically a straight path to earth. They overcome many of the troubles of the older forms, due to an insufficient surface distance on the arrester base, between parts of opposite potential.

Many arrester failures are due to the use of iron boxes. An iron box offers an inductive effect to a discharge, and this effect becomes very marked as the frequency of the oscillations increases. Often the discharge jumps around the insulating bushings surrounding the leading-in wires, the normal current follows, and establishes a serious short circuit. Wooden or asbestos lumber boxes are greatly to be preferred; the former are cheaper than iron and quite durable, while the latter have their fireproof qualities to recommend them. For car service asbestos lumber boxes should always be used, as any lightning arrester, unless properly fireproofed, may burn out and hazard valuable apparatus.

If arresters are properly designed to meet service conditions; if they are properly installed and frequently inspected to see not only that the arresters themselves are in good condition, but that the ground connections are likewise, users may reasonably expect several years' service from an equipment of the present-day lightning arrester.

If tell-tale papers be put in the gaps of lightning arresters it will be a matter of considerable surprise to note the number of discharges taken. If this practice is continued for a period of two or three years, it will enable railway operators to determine where discharges most frequently occur, and at these points arresters may be installed more frequently and better results thereby secured.

As a sample of what has been accomplished by careful inspection, one of the large interurban roads in the centre of the lightning belt of Indiana has shown a total loss of lightning arresters of less than two per cent. of the entire equipment per year for three years. This company inspects its arresters frequently, and the saving of lightning arresters due to this inspection, together with the increased protective efficiency of their arrester equipment, has more than paid for the inspection.

Another company, located in practically the same territory, operating at 1,200 volts d.c. since 1906, has lost or had partially damaged in the past three years, a total of but six arresters out of 225 originally installed, and during that time has lost absolutely nothing in the way of equipment. On this property frequent and careful inspections are the rule.

The foreging statements refer throughout to lightning protection of direct current circuits. A large part is equally pertinent in relation to alternating current circuits. The design of alternating current lightning arresters has presented very different but quite as difficult problems as direct current railway circuits.

The characteristics of alternating current are taken advantage of very nicely in practically all modern types of a.c. lightning arresters. The use of several air-gaps in series, where the current flow is limited to certain values by various means, results in the failure of the arc in the gaps, when the current wave passes through zero. In some forms of a.c. arresters this action is supplemented by shunting some of the gaps with a series of resistance; in others, a circuit-breaker cuts off the flow of normal current, if for any reason the air-gaps fail to respond promptly.

There is no more fitting conclusion than to remark that the price of satisfactory lightning protection is proper installation and inspection. The manufacturers to-day may be said to have done very well with this problem, as is evidenced by highly satisfactory general results. But these satisfactory results are secured only when the operating companies co-operate by giving the arrester installation the proper care.

# ENGINEER'S LIBRARY

## THE CANADIAN ENGINEER'S MONTHLY INDEX OF CIVIL ENGINEERING LITERATURE.

The purpose of this monthly index is: To inform engineers and contractors of the literature published on those subjects in which they are especially interested, the character of the article and the journal in which it appeared. **We do not index in this section articles that appear in The Canadian Engineer.**

Periodicals containing articles indexed, should be ordered direct from the publishers.

### LIST OF PERIODICALS INDEXED.

**Canadian Society of Civil Engineers Proceedings.**—(Can. Soc. C. E. Proc.), Montreal, Can., m., 4 x 7 in., 50 cents.

**Canadian Cement and Concrete Review.**—(Can. Cem. and Con. Rev.), Toronto, Ont., m., 9 x 14, 15 cents.

**Contractor.**—(Contr.), Chicago, Ill., bi.-w.; 7 x 10 in., 20 cents.

**Engineering—Contracting.**—(Eng.-Cont.) Chicago, Ill., w.; 9 x 12 in., 10 cents.

**Engineering News.**—(Eng. News), New York, N.Y., w.; 10 x 14 in., 15 cents.

**Engineering Magazine.**—(Eng. Mag.), New York, N.Y., 7 x 10 in., 25 cents.

**Machinery.**—(Mach.), New York, N.Y., m., 7 x 11 in., 20 cents.

**Municipal Journal and Engineer.**—(Mun. Jl. and Eng.), w., New York, N.Y., 9 x 12, 10 cents.

**Municipal Engineering Magazine.**—(Mun. Eng. Mag.), Indianapolis, Ill., m., 7 x 10 in., 25 cents.

**Power and Engineer.**—(Pow. and Eng.), New York, N.Y., w.; 9 x 12 in , 5 cents.

**Railway Age Gazette.**—(R. R. Age Gaz.), New York, w.; 8 x 11 in., 15 cents.

**Surveyor, The.**—(Sur.), London, Eng., w.; 6 x 11, 10 cents.

**Engineering.**—(Engr.), London, Eng., w.; 12 x 15 in., 15 cents.

## POWER AND LIGHT.

**Power House, Rock Island R.R. Shops.***—Six pages. Pow. and Eng., Oct. 19, 1909. Describes building, coal plant, boiler-house, etc.

**Value of a Water Power.***—Two pages. Pow. and Eng., Oct. 12, 1909. Simple methods for making an estimate of the available power.

**Measuring Flow of Water*.**—Six pages. Pow. and Eng., Oct. 5, 1909. Measuring water by Venturi meter and weir. Construction and theory.

**Choosing a Motor.***—Four pages. Pow. and Eng., Oct. 6, 1909. Views of two experienced engineers on advisable features of construction, speeds, windings and ratings of direct-current motors.

**Speed of Electric Motor.**—Four pages. Pow. and Eng., Nov. 1, 1909. An elementary explanation of the principal methods used to vary the speed of a shunt-wound motor running on a two-wire circuit.

*Illustrated

## ROADS AND PAVEMENTS.

**Destructive Effect of Motor Traffic on Macadam Roads.**—One page. Eng.Cont., Oct. 20, 1909. The result of tests on the causes of destruction, with special attention to motor traffic.

**Street Grades.***—Three pages. Mun. Jl. and Eng., Oct. 20, 1909. Tells of the system of establishing street grades in New York.

**Cost of Hauling.***—Four pages. Cont., Nov. 1, 1909. Gives detailed costs of hauling in Ohio of wagons, first, by traction engines, and second, by two-horse wagons.

## RAILWAYS.

**Consolidated Locomotives.***—Four pages. R.R. Age, Oct. 15, 1909. Details of the Walschaerts valve gear on Lackawanna R.R.

**Tonnage Formula for Train Loads.**—One page. R.R. Age, Oct. 22, 1909. "Adjusted tonnage" method of calculating train loads.

**Signals.***—Four pages. R.R. Age, Oct 8, 1909. Describes the new signals at Providence on the New York, New Haven and Hartford.

**Signals.***—Five pages. R.R. Age, Oct. 8, 1909. System in the new tunnels of the Hudson and Manhattan.

**Locomotive Tractive Effort.**—Two pages. R.R. Age, Nov. 5, 1909. Formula and table used on the Southern Railway for obtaining quickly the tractive effort of locomotives.

## CONCRETE AND REINFORCED CONCRETE.

**Cost of Reinforced Concrete Pile Dyke.***—One page. Eng.-Cont., Oct. 20, 1909. Gives cost of dyke built on the Missouri River.

**Viaduct of Concrete.***—Three pages. Contr., Oct. 15, 1909. Details of reinforced concrete bridge in California.

**Reinforced Concrete Columns.***—One page. Eng., Sept. 24, 1909.

## SEWERS, SEWAGE AND WATERWORKS.

**Brooklyn Water System.***—Two pages. Contr., Oct. 15, 1909. Describes how excavation was done by drainage excavators.

**Louisville Sewerage Improvements.***—Two pages. Eng. News., Oct. 14, 1909. Gives details of sewer dimensions, etc.

**Cost of Laying Water Pipe.**—Half page. Eng.-Cont., Oct. 13, 1909. Gives cost of work in Cleveland, Ohio.

**Filters.***—Two and a half pages.—Mun. Jl. and Eng., Oct. 6, 1909. Describes the filters in use at Rock Island, a town with a population of 28,000.

## MISCELLANEOUS.

**Gas Producer for Low-grade Fuel.***—One page. Pow. and Eng., Oct. 19, 1909. Describes the Deutz gas producer.

**Liability Insurance for Contractors.**—One page. Contr., Oct. 15, 1909. The article outlines the advantage to contractors of insurance.

**Rolling of Special Sections of Iron and Steel.***—One page. Eng. News, Oct. 7, 1909.

**Direction Marks for Maps.***—One page. Eng. News, Oct. 7, 1909. The article gives a series of different designs used for marking direction on plans.

**Cost of Drainage Work.***—Five pages. Eng. Cont., Oct. 13, 1909. Method of drainage and cost in Illinois.

**Stresses Produced by Shocks.**—One and a half pages. Mach., Oct., 1909.

**Shafts for Turbines.**—Two pages. Eng., Sept. 24, 1909. Shafts for turbine vessels.

**Some Causes of Belt Failures.***—Two and a half pages. Mach., Nov., 1909.

* Illustrated.

## BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

**Concrete, Plain and Reinforced,** by Frederick W. Taylor, D. Sc., and Sanford E. Thompson, M. Am. Soc. C. E. Published by The Renouf Publishing Company, Limited, Montreal, Que.; John Wiley & Sons, 43 East Nineteenth Street, New York; and Chapman & Hall, Limited, London, England. Price $5.00 net.

This is a second revised and enlarged edition brought up to date. It is over one hundred pages larger than the first edition, and contains special chapters by R. Feret, W. B. Fuller, F. P. McKibben, and S. B. Newberry, which include some of the very latest designs and information.

While either plain or reinforced concrete are in themselves subjects of considerable magnitude, nevertheless in this volume, which contains upwards of eight hundred pages of readng matter, there is sufficient room to deal exhaustively with both. Concrete contractors and engineers throughout America are sufficiently conversant with the names of Sanford E. Thompson and Frederick W. Taylor as to accept this book on the strength of their names as authors. It is most complete. Every branch of the subject has received such attention as it merits in the eyes of those practically engaged in concrete work. Unimportant subjects and antiquated methods and designs have been kept in the background. Concrete engineers and builders will find but little in this large volume that cannot be found of practical value in the construction work of to-day.

Some new ideas have been introduced in the make up of this edition that will facilitate its use as a text and reference book on concrete. The arrangement of the chapters has evidently been made with this in view as a logical order has not been followed throughout. The first 250 pages are more or less elementary, but they are most complete and subjects of the utmost importance, such as tests, specifications, choice of cements, etc., have been dealt with at some length. Numerous tables of weights and volumes will be found exceedingly useful. Chapter 1 is of special interest in so far as it points out many of the essentials of concrete construction and warnings against the most serious errors that have frequently been made in field. The greater portion of the book deals with present day methods for all manner of concrete work and is most complete. It would be impossible to cover this portion of the book unless at great length as eighteen chapters have been donated by the authors to this section, as well as several appendices. The last chapter contains a comprehensive list of valuable books and articles relating to the various subjects referred to as well as the names of authors, arranged alphabetically. This book is one of the most comprehensive that have come to our notice. It is up-to-date and most practical.—A. E. U.

**Principles of Reinforced Concrete Construction,** by F. E. Turneaure, Dean of the College of Engineering, University of Wisconsin, and E. R. Maurer, Professor of Mechanics, University of Wisconsin. Published by Renouf Publishing Company, Limited, Montreal, and John Wiley & Sons, New York. Price $3.50 net.

This book treats principally with the theoretical side of reinforced concrete construction and its application to miscellaneous structures, such as arches, dams, retaining walls, etc., as well as buildings generally. It appeals more to the engineering student and technical reader rather than the practical builder and contractor. The first six chapters in particular deal exhaustively with the theoretical side of the subject. The last five chapters however, deal with the application of the principles outlined in the former chapters and will, in themselves, be found instructive though incomplete in cases where the technicalities of the subject are of little interest to the reader or difficult of interpretation. In brief, chapters I. to VI. treat of the theory of the subject and the results of experiments. The remaining chapters treat of the use of reinforced concrete in various forms of structures. The entire work is replete with tables and diagrams necessitating a careful study. Without a thorough knowledge of the principles of mechanics, it is doubtful whether the reader would be able to apply the principles as narrated, underlying the design of reinforced concrete. The theoretical chapters of the book treat with the properties of concrete, of reinforcing steel and of concrete and steel in combination, stresses in beams, tests of beams and columns, working stresses and general constructive details, as well as numerous formulae, diagrams and tables. This book is the second edition, revised and enlarged by over one hundred pages, which include the result of recent important experiments that will be found of interest.—A. E. U.

**Concrete,** by Edward Godfrey. Published by the author at Monongahela Bank Building, Pittsburg, Pa. Pages, 450. Size, 4 x 6. Leather. Price, $2.50.

This book was written to point the way to sound engineering in concrete, by enunciating the principles thereof and by laying bare the falsity of much that passes for good engineering. The aim was to teach, not by example, but by laying stress on the principles that should govern in all design.

There are four general divisions to the book. First, some 180 pages given to information relative to the materials used in making concrete and reinforced concrete.

Second, some 75 pages consisting of articles by the author published in engineering journals, together with letters of criticism, on beams, and slabs, columns and footings, and retaining walls.

The third section of 155 pages takes up beams and slabs again, the arch, foundations, shear of concrete and its bearing on the design of beams, the columns, dams and their design and the design of domes, vaults and conical coverings.

The last section consists of cuts showing piers, small arches, culverts, etc., as illustrating current practice.

Any man anxious to be well informed on concrete and reinforced concrete design will find much in this book that assist in making him familiar with this subject as well as giving him confidence in design.

**Calculators,** by the Dodge Manufacturng Company, Mishawaka, Ind. Price 25 cents.

This calculator is well made and nicely encased in leather. It has six scales and by its aid one can quickly

calculate the pulley speed, power that may be transmitted, size of pulley or belt required, size of shafting and power certain sizes will transmit. Altogether a most useful calculator.

**Welding and Cutting Metals by Aid of Cases or Electricity,** by Dr. L. A. Groth, Consulting Engineer. 267 pages, 5½ x 8¾. Price 10/6, or $2.50 net. Published by Archibald Constable Company, Ltd., London, England.

As pointed out in the preface of this book, welding is used to a far greater extent than is generally supposed. Reliable data as to either the relative values of alternative welding processes, or welded unions as compared to joints effected by other means, are difficult to procure, especially if such information is desired in a hurry. That the author of the book has recognized this fact, is very evident from the careful attention to accuracy exhibited throughout the various chapters.

The description of the historical development of the present day manufacture of the various gases used in welding is extremely complete. This, together with the pages devoted to the theory and practice of the various welding methods and the construction of blow pipes suitable for the use of gases in welding, constitute three very interesting chapters both from the standpoint of the engineer and the manufacturer.

The electrical and "Thermit" processes, together with aluminium welding, the accomplishment of which is so difficult, are thoroughly gone into, the dangers and advantages of the different methods being very intelligently pointed out.

The most valuable portion of the book from the engineering standpoint is that devoted to the welding of sheet iron and steam boilers. In the discussion, is given a large amount of certified information from various engineers and directors of works as to the relative reliability of welded as compared with cast iron pipes. Passing to the subject of welding steam boilers, many details of actual cases in which welding has been aplied both in constructing new and in repairing old boilers are given. The necessity of employing only experienced men on such work is clearly shown.

The chapter on cutting metals by either gases or by electrical means needs no comment. It is in keeping with the preceding pages.

The remainder of the book is taken up with the description of accidents that have happened in welding practice and the resultant legislation relative for the manufacture of gases and their subsequent use.—T. R. L.

**A Study of the Open Hearth,** by Harbison-Walker Refractories Company, Pittsburgh.

It would seem rather a presumption to call this book a "Study" of the open hearth furnace. It is, in fact, a synopsis of open hearth practice. There are six chapters embracing the construction of open hearth furnaces, Acid and Basic; and their operation; fuels used, recarbonization; and a concise description of special processes.

The book, extremely well bound in pocket size, (6½ ins. x 4 ins.) would be of value to any salesman who has to do with iron and steel products, in as much as it would give him a grasp of the manufacture of Open Hearth steel and thereby enable him to more intelligently handle his wares. —T. R. L.

**Applied Statics,** by T. R. Loudon, B. A. Sc. Published by The Canadian Engineer Press, 62 Church Street, Toronto, Ontario. Size 6 x 9. Pages 100. Price $1.00.

The author in preparing this text had apparently two objects in view. First, to treat the subject so that the reader could follow every step in the discussion, and second, to apply the theory to practical problems.

The first few chapters are taken up with the theory of the subject and the matter is dealt with clearly and very fully. The remaining chapters deal each with some particular subject; method of sections; the beam; shearing forces; pulley systems; friction and wind pressure.

In the issue of the Canadian Engineer, October 22nd, Mr. Loudon commenced a series of problems applying the theory he has discussed in this book. These problems will continue for the next five months and together with this text should provide the young engineer, anxious to review or work up his mathematics, an excellent programme of study.

## PUBLICATIONS RECEIVED.

**"Fuel Tests with Illinois Coal."**—By L. P. Breckenridge and Paul Diserens, issued by the Engineering Experiment Station of the University of Illinois as Circular No. 3. It consists of a compilation of data relating solely to the coals of the State of Illinois, selected from the complete reports of the Government investigations on the fuels of the United States. Copies of circular No. 3 may be obtained gratis on application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

**Direct and Alternating Current Testing.**—By Frederick Bedell, Ph.D., Professor of Applied Electricity in Cornell University, assisted by Clarence A. Pierce, Ph.D.; 300 pp., 6 x 9; cloth, $2, net. Published by D. Van Nostrand Company, 23 Murray, and 27 Warren Streets, New York City.

**Concrete.**—By Edward Godfrey, structural engineer for Robert W. Hunt & Company. 500 pp., pocket size, leather cover. Price, $2.50 net. Published by the author, Pittsburg, Pa.

**Proceedings of the First Meeting of the Illinois Water Supply Association,** held at the University of Illinois, February 16th and 17th, 1909; 200 pp., 6 x 9. Published by the Society, Urbana-Champaign, Ill.

**Principles of Reinforced Concrete Construction.**—By Mr. F. E. Turneaure, Dean of the College of Engineering, University of Wisconsin, and Mr. E. R. Maurer, Professor of Mechanics, University of Wisconsin; second edition; 430 pp., 6 x 9; $3.50. John Wiley & Sons, publishers, New York, U.S.A.; Chapman & Hall, Limited, London, Eng.

**A Treatise on Concrete: Plain and Reinforced.**—By Frederick W. Taylor, M.E., Sc.D., and Sanford E. Thompson, S.B., M. Am. Soc. C.E., second edition; 800 pp., 6 x 9; price, $5. John Wiley & Sons, publishers, New York City, U.S.A.; Chapman & Hall, London, England.

**A Treatise on Masonry Construction.**—By Ira Osborn Baker, B.S., C.E., D. Eng., Professor of Civil Engineering, University of Illinois; tenth edition, 6 x 9, 746 pages, 100 tables and 244 illustrations; cloth, $5, net. John Wiley & Sons, publishers, New York City; Chapman & Hall, Limited, London, Eng.

**Field and Office,** and **Railroad Curves and Earthwork,** two books.—By C. Frank Allen, S.B., Mem. Am. Soc., C.E., Professor of Railroad Engineering in the Massachusetts Institute of Technology; 4th edition, 220 pp., gilt edges, pocket size, leather bound, $2 each. Spon & Chamberlain, publishers, 123 Liberty Street, New York, U.S.A.

**Report of the Chief Engineer of the Board of Estimate and Apportionment** of the city of New York, U.S.A., for 1908, 400 pages, 6 x 10. Mr. Nelson P. Lewis, chief engineer.

**The Recognition of Minerals.**—By C. G. Moore, M.A., F.I.C., with monographs on geology, ore deposits, etc., by Donald A. MacAlister, Assoc., R.S.M., F.G.S., 250 pp., 6 x 9; cloth, $1.85. Published by the Mining Journal, 40 Queen Victoria Street, London, E.C., England.

**Efficiency as a Basis for Operation and Wages.**—By Harrington Emerson, 175 pp., 6 x 9, cloth. The Engineering Magazine, publishers, New York, U.S.A.

**Power Railway Signalling.**—By H. Raynar Wilson, late of the L. & Y., and Midland Railways of England, 350 pages, 9 x 12; cloth, $7.25. Published by The Railway Engineer, 3 Ludgate Circus Buildings, London, E.C., England.

**Secondary Stresses in Bridge Trusses.**—By Mr. C. R. Grimm, C.E., M. Am. Soc. C.E., 6 x 9, 150 pages, 60 illustrations, and 13 numerical examples. Cloth, $2.50. John Wiley & Sons, publishers, New York. Renouf Publishing Company, 61 Union Ave., Montreal, agents for Canada.

**Irrigation Engineering.**—By Herbert M. Wilson, C.E., M. Am. Soc. C.E., Chief Engineer, United States Geological Survey, 650 pp., 6 x 9, and 38 full page plates, and 195 figures; cloth, $4. John Wiley & Sons, publishers, New York, U.S.A.; Renouf Publishing Company, 61 Union Ave., Montreal, Que.

**Practical Testing of Gas and Gas Meters.**—By C. H. Stone, B.S., M.S., chief inspector of gas, Public Service Commission, Second district, New York, 350 pages, 6 x 9; numerous illustrations. John Wiley & Sons, publishers, New York, U.S.A.; Renouf Publishing Company, Montreal.

**Structural Details or Elements of Design in Heavy Framing.**—By Henry S. Jacoby, Professor of Bridge Engineering, Cornell University, 375 pp., 6 x 9, and 40 illustrations, $2.25 net. John Wiley & Sons, publishers, New York, U.S.A.; Renouf Publishing Company, Montreal.

**Report of the Sanitary State of the City of Montreal,** also an account of the operations of the Board of Health and the Vital Statistics for the year 1908, by Dr. Louis Laberge, Medical Officer of Health. 107 pp., 6 x 9 pub. doc.

**Proceedings** of the first annual general assembly of the Architectural Institute of Canada, held in Ottawa on the 28th, 29th and 30th September, and 1st October, 1908. 140 pp., 6 x 9. Alcide Chausse, M.S.A., Secretary, P.O. Box 259, Montreal, Que.

**The Bridges of New York.**—By Mr. T. Kennard Thomson, M. Can. Soc. C.E., Consulting Engineer, 50 Church Street, New York City. 70 pages, 6 x 9, well illustrated.

## CATALOGUES.

**Foundry Facings.**—A booklet of handy size has just been issued by the Joseph Dixon Crucible Company, Jersey City, N.J., descriptive of foundry facings. Much valuable information on the proper use of facings is given, and the listings, which include prices, will be of interest to the purchasing agent.

**Corrugated Steel Sheet Piling.**—The uses of this material are illustrated and described in a folder issued by the Wemlinger Steel Piling Company, 11 Broadway, New York City. Information concerning work in which the piling is used, including the construction of bridge piers, coffer dams, sewer trenches, waterworks, subways, etc., will be gladly forwarded on application.

**The Peerless "Pickup" Hand Sweepers** are described and illustrated in a book just issued by the Barron & Cole Company, 127 Franklin St., New York City. The machine is used on streets, in parks and factories, on railroad platforms, etc. Many good recommendations are given, and the volume is worthy of consideration from municipal authorities interested in the street cleaning problem.

**Road-making Machinery** is described in a booklet entitled "Cheaper and Better Roads." Published by the Baker Manufacturing Company, Fisher Building, Chicago, Ill., it tells how to cheapen expenses in grading, ditch digging, drainage work, irrigation, and a host of other things in which the highway and municipal engineer are interested.

**How to Mix and Place Concrete for Five Cents a Cubic Yard** is the title of a publication distributed by the Nims Concrete Machinery Company, 127 Franklin Street, New York City. Instances are cited in which the cost of concrete work was extremely low, while an interesting article on the Actual Cost of Mixing and Placing Concrete in a Dam is also included.

**The Milburn Light.**—An improved gas light, generated from acetylene, and used by contractors, railways, mining companies, foundries, lighthouses and dockyards—is the subject article in a book published by the Alexander Milburn Company, of Baltimore, Md., U.S.A. Particulars as to its cost are given, together with illustrations showing its adaptability.

**Modern Street Railway Lamps** are described in Bulletin 5B, issued by the engineering department of the National Electric Lamp Association, 4411 Hough Ave., Cleveland, Ohio.

**Gas Engines** for electric lighting, pumping and general power purposes are described and illustrated in an interesting booklet prepared by the Bruce-Macbeth Engine Company of Cleveland, Ohio. Comparative fuel costs of different kinds of power, including that produced by the steam engine and the gas engine, are given, while there are also much other data that will interest the engineer and purchasing agent who is connected with municipal and private plants in which this kind of machinery is used.

**Road-making Machinery.**—Contractors and township supplies, and high-grade traction and portable engines are described by Messrs. Sawyer and Massey Company, Limited, of Hamilton, Ontario, in a booklet with which we have been favored. Municipal engineers and the members of boards of works of town and city councils will find in this publication descriptions of some of the best road-making equipment manufactured in Canada.

**Engine Indicators.**—The Trill Indicator Company, of Corry, Pa., has just issued an attractive 44-page booklet describing their various types of indicators. This book also describes the Faultless Reducing Motion, Trill Planimeter, and Indicators for high pressure and ammonia work. Besides the description of the apparatus, interesting discussions are given on numerous cards and the causes of various unusual curves pointed out. A method is also given for drawing adiabatic and saturation curves.

**Electrical Machinery.**—Bruce, Peebles & Company, Edinburgh, Scotland, send an interesting series of catalogues describing induction motors, continuous current motors, alternators, continuous current dynamos, motor-converters, and special machinery.

**Gas Engine Tests.**—The Colonial Engineering Company, 222 St. James Street, Montreal, Que., in their booklet, Cost of Power, give interesting information as to what the power user should pay for light, heat and power. They also give the results of several tests made on their engines.

**Buckets, Orange Peel and Clam Shell.**—The Hayward Company, 50 Church Street, New York, have in the most substantial and modern design these two styles of buckets. They also make buckets to special designs, and the Hayward bucket will handle any digging problem.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal President, George A. Mountain; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto. Meet last Thursday of the month.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coultee, Box 560, Ottawa; S. J. Chapleau, Box 203.

**MUNICIPAL ASSOCIATIONS.**

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

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UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

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## CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator Company, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE. — Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB. — President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, C. A. Jeffers; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY. — President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrell.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB. — President Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

## AMERICAN TECHNICAL SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS. — President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS. — President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

(Continued on page 50.)

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Nov. 7 1909 | EARNINGS Week of Nov. 7 1908 | STOCK QUOTATIONS TORONTO Price Nov. 5 '08 | Price Oct. 28 '09 | Price Nov. 4 '09 | Sales Week End'd Nov. 4 | STOCK QUOTATIONS MONTREAL Price Nov. 5 08 | Price Oct. 28 09 | Price Nov. 4 '09 | Sale Week End'd Nov. 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,113,000 | 1,688,000 | | 173¼ | 184½ 183½ | 184½ 30 | 175 | 174½ | 183¾ 183½ | 184½ 184 980 |
| Canadian Northern Railway | 2,986.9 | | | 340 300 | 256,900 | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 902,197 | 837,226 | | | *1st. pref. 108½, 3rd pref. 57½, ordinary 23½ | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | | | | | | | | | | |
| Montreal Street Railway | 138 3 | 18,000 | 100 | 74,794 | 68,578 | | | | | 200 | 199½ | 207½ 202 | 209 208½ 788 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,053 | 68,482 | | 101 | 123 122½ | 123¾ 99 | | 105¼ | 12 3 128 | 124½ 123½ 3803 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 170 | 168 | 183 | 182½ 62 | | 109 | | |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILWAY EARNINGS FOR OCTOBER.

| Company | Month of Oct., 1909 | Month of Oct., 1908 | Increase | Jan. 1 to Oct. 31, 1909 | Jan. 1 to Oct. 21, 1908 | Increase |
|---|---|---|---|---|---|---|
| Canadian Pacific Railway | $9,684,000 | $7,349,000 | $2,335,000 | $66,956,860 | $56,130,000 | $10,826,860 |
| Canadian Northern Railway | 1,384,200 | 1,172,700 | 211,500 | 8,154,600 | 7,272,800 | 881,860 |
| Grand Trunk Railway | 4,043,361 | 3,786,170 | 257,191 | 33,523,441 | 31,949,954 | 1,573,487 |
| Temiskaming & N. O. Railway | 161,360 | 91,270 | 70,090 | 1,244,222 | 689,242 | 554,980 |
| Montreal Street | 305,652 | 280,059 | 25,593 | 2,947,579 | 2,776,613 | 170,966 |
| Toronto Street | 332,453 | 306,456 | 25,997 | 2,916,217 | 2,052,079 | 264,138 |
| London Street | 19,047 | 18,210 | 837 | 198,156 | 193,376 | 4,780 |
| Totals | $15,930,079 | $13,003,871 | $12,926,208 | $115,941,135 | $101,664,064 | $14,277,071 |

No minus signs are required in the accompanying table. Which means that the earnings of Canada's most important railways continue to increase. This is probably the best indication of the trend of progress that can be cited. Continually for the past few months have records been broken by our biggest road—the Canadian Pacific. As the reader will observe, the figures for the month of October alone, when compared with returns for the same period a year ago, show an increase of nearly two and a half million dollars, while the difference between the figures relating to the first ten months of this year and last year represents nearly eleven million dollars. In no other way is the story of Canada's march of progress better told.

While the statistics affecting the T. & N. O., the Canadian Northern and the Grand Trunk are encouraging, the figures giving the increase of the latter have, on several occasions, been larger. Comparing returns for the past two months, it will be seen that increases are general with the exception of the Toronto and Montreal Street Railways, whose earnings for September were augmented by the Canadian National Exhibition of Toronto and Old Home week celebrations at Montreal.

## HAMILTON STREET RAILWAY

Hamilton.—Street Railway earnings for the last quarter amounted to $101,239.40, the largest in the history of the company. This is attributed largely to the improved service, since the reconstruction work on James and Barton street was completed this year. A comparison of the earnings for the first three-quarters of this year and the corresponding periods last year is interesting.

| | 1908. | 1909. |
|---|---|---|
| March | $ 64,281.58 | $ 68,260.47 |
| June | 78,373.03 | 82,453.14 |
| September | 93,260.03 | 101,239.40 |
| Total | $235,915.64 | $251,933.01 |

## RAILWAY EARNINGS.

We were unable to give the earnings of the following railways for the last week of October with the figures relating to the other roads which we published on page 520 of our issue per last week:—

| | 1909. | 1908. | Increase. |
|---|---|---|---|
| Grand Trunk | $1,321,050 | $1,287,065 | $33,985 |
| T. & N. O. | 54,588 | 31,404 | 23.184 |

Appended is a statement which contains figures relating to the past two months:—

| | October, '09. | Sept., '09. |
|---|---|---|
| C. P. R. | $9,684,000 | $8,148,000 |
| C. N. R. | 1,384,200 | 1,076,000 |
| G. T. R. | 4,043,361 | 3,959,004 |
| T. & N. O. | 161,366 | 153,217 |
| Montreal St. | 305.652 | 307.489 |
| Toronto St. | 332,453 | 379.581 |
| London St. | 19,047 | 24.645 |
| | $15,930,079 | $14,047,936 |

## EDMONTON STREET RAILWAY.

The month of October just past saw the completion of the first year of actual operation of Edmonton's municipal street railway. The number of passengers carried on the street cars increased steadily throughout the year, and October crowned them all with 242,666 passengers carried, and a net revenue realized of $10.224. The increase in the number of passengers over the preceding month of September was 22,018. The increase in revenue was $617 taken in during the month of November $9,607.

## RAILWAYS AND CANALS OF CANADA.

(Expenditure on Construction for Past Year.)

The annual report of the Department of Railways and Canals, issued on Tuesday, shows a total capital expenditure on railways during the past fiscal year of $29,414,227, of which $24,892,422 was on the National Transcontinental Railway.

On canals the capital expenditures were $1,873,868. These expenditures bring the total capital expenditure to the present time on railways up to $215,148,689 and on canals to $95,331,742.

The statement of receipts and expenditures of the Intercolonial Railway during the year shows that, as compared with the preceding twelve months, there was a decrease in the gross earnings of $646,489.07, of which $83,189 was in passenger traffic and $551,942 in freight traffic. A comparison of the working expenses for the same period shows an increase of $124.41 per mile of railway and ten cents per train mile.

The traffic through the several canals of the Dominion for the season of 1908 amounted to 17,502,820 tons, a decrease of 3,040,819 tons, as compared with the previous year.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Newfoundland**

ST. JOHNS.—Canadian manufacturers of railway materials have another opportunity to tender for a valuable contract in Newfoundland. Mr. J. E. Ray, Canadian Trade Commissioner at St. John's, reports to the effect that the Reid Newfoundland Company are building a branch railway 100 miles in length. Work on the permanent way has just commenced under 2,000 men, but the rails will not be laid until next spring. Manufacturers of steel rails, bridges and railway materials should apply to H. D. Reid, The Reid Newfoundland Co., St. Johns, Newfoundland.

**Quebec.**

ARTHABASKA.—The secretary-treasurer of the council of the County of Arthabaska will receive up to Thursday, December 9th, tenders for the construction of a steel bridge on the Becancour River, between the municipalities of St. Louis of Blandford and the township of Stanfold. Louis Lavergne, secretary-treasurer.

HULL.—Tenders will be received until Monday, 6th December, 1909, for pumping equipment. R. W. Farley, City Engineer. (Advertisement in the Canadian Engineer.)

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

MONTREAL. — Tenders will be received up to noon, Wednesday, 17th November, for the construction of Police and Fire Stations combined, corner of Mountain Avenue and Marechal Street, Mount Royal Ward, and corner of Third Avenue and Masson Street, Rosemount, St. Mary's Ward. The plans and specifications may be seen at the office of Mr. L. R. Montbriant, architect, 230 St. Andre Street. L. O. David, City Clerk.

QUEBEC.—Tenders will be received until Tuesday, the 30th November, for the building of the substructure of the Quebec Bridge. The general specification and form of tender will be ready about November 20th; but in the meantime contractors are invited to visit the office of the Quebec Bridge Board of Engineers, Canadian Express Building, Montreal, for the purpose of securing preliminary information to enable them to submit tenders for this work. L. K. Jones, secretary, Department of Railways, and Canals, Ottawa.

**Ontario.**

BURLEIGH FALLS.—Tenders will be received up to Tuesday, 16th November, for the works connected with the construction of a concrete dam at Burleigh Falls, on the Trent Canal. L. K. Jones, secretary, Department of Railways and Canals, Ottawa.

DUNNVILLE.—Tenders will be received until Thursday, November 18th, for constructing a system of sanitary sewers comprising about 18,000 lineal feet of tile sewers. the contractor to furnish all materials therefore. The entire work is to be completed on or before August 31st, 1910. Robert Bennett, Mayor; J. W. Holmes, town clerk; Willis Chipman, chief engineer, 103 Bay Street, Toronto.

FLETCHER.—Tenders will be received until 15th November, 1909, at noon for the contruction of drainage work in the township of Tilbury East, according to the report, plans and specifications of J. J. Newman, C. E., said work being as follows:—For enlarging and improving a part of the outlet of No. 2 and No. 3 Government drains in said Township and making embankments on each side of same estimated cost $9,960. Alex. Farquharson, Clerk.

LONDON.—Tenders will be received until Wednesday, November 10th, for underground conduit and cable system for electric light and power supply. Tenders are also invited until November 22nd on the transformers, motor generator set, voltage regulators, switchboards, lightning protectors, instruments, arc and incandescent street lighting systems, and other electrical apparatus. Address, Mr. E. I. Sifton, Electrical Engineer, City Hall.

OWEN SOUND. — John Harrison & Sons Company, Limited, of this town are advertising for tie timber. They will pay high prices for Tamarac and Cedar, 7½ inches or over at the top; 8 feet lengths or multiples.

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received up to Tuesday, November 16th, for steam fire-engines and life-saving machines. Joseph Oliver, Mayor, Chairman Board of Control.

TORONTO.—Tenders will be received until Wednesday, November 24th, for pole line supplies. Specifications may be seen at the Electrical Department. Jos. Oliver, (Mayor), Chairman, Board of Control. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, November 22, for additions and alterations to the Toronto General Post Office. Plans may be seen at the office of Mr. Thomas Hastings, clerk of works, Customs Buildings, Toronto; N. Tessier, secretary, Department of Public Works, Ottawa. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders for electric wiring in the branch library on the north-west corner of Gerrard Street and Broadview Avenue will be received up to Thursday, November 25th. E. S. Caswell, Secretary-Treasurer, Toronto Public Library.

TORONTO.—Tenders for steam fire engines and life-saving machines will be received up to noon Tuesday, November 16th, Mr. Jos. Oliver, (Mayor), Chairman, Board of Control.

**Manitoba.**

HARTNEY.—Tenders will be received up to December 6th, at 5 p.m., for the construction of a pile bridge across the Souris river on section 25—5—25, near Lauder. Plans and specifications may be seen at my office in Hartney. T. B. Woodhull, secretary-treasurer, Municipality of Cameron.

WINNIPEG.—Tenders are invited by the Board of Control for the construction of numerous sewers. M. Peterson, secretary; Col. Ruttan, city engineer.

WINNIPEG.—Tenders are invited until Thursday, November 18th, for 100 six-inch fire hydrants, for the domestic waterworks system. Colonel Ruttan, City Engineer; M. Peterson, secretary, Board of Control.

WINNIPEG.—Tenders will be received for drainage, requiring approximately the removal of over 200,000 cubic yards of material, up to noon of Monday, the 22nd of November. Arthur Stewart, 323 Main Street.

**Saskatchewan.**

REGINA.—Tenders will be received up to Monday, November 15th, for the construction of two reinforced bridge abutments for a highway traffic bridge, to be constructed over the Notekeu creek. F. J. Robinson, Deputy Commissioner, Department of Public Works.

**British Columbia.**

NORTH VANCOUVER.—Tenders are invited until Thursday, November 18th, by Alexander Phillip, clerk of the municipality for $30,000 general, $17,474 local improvement, and $15,000 water district debentures.

REVELSTOKE.—Tenders will be received until November 15th, for 1,130 feet wooden pipe, continuous stave,

in place; concrete dam and gate house, containing about 5,000 yards, and for 4,000 barrels Portland cement. Smith, Kerry & Chace, engineers, Winch building, Vancouver, B.C., and at Calgary, Alta., where further particulars may be obtained.

VANCOUVER.—A twenty-mile ditch system is being constructed for the Quesnelle Hydraulic Gold Mining Company, in the Cariboo Mining district by Messrs. Burr & Ferguson, civil and hydraulic engineers, 216 Loo Building Vancouver, who are in the market for supplies required in connection with the construction of dams, tunnels, ditches, flumes, pipe lines, etc., and invite manufacturers of such material to forward them descriptive literature.

## CONTRACTS AWARDED.

**Nova Scotia**

HALIFAX—Tenders for supplying three thousand feet of 2½-inch hose, three hundred feet of chemical hose and some suction hose were not considered by the board of works, at their recent meeting, because the specifications called for a four-year guarantee and the tenders submitted were only on the basis of a three-year guarantee.

**Quebec.**

MONTREAL.—A contract was awarded for paving work to Laurin & Leitch, by the St. Louis Council.

MONTREAL.—The Water Committee awarded a contract to Messrs. Muir and Son, for 12,000 tons of Old Mines Sydney soft coal at $3.65 per ton. This is the lowest figure the city has paid for a long time.

**Ontario.**

OTTAWA.—The Government has formally awarded the contract for the construction of the Kippewa dam to Morrow and Beattie, of Peterborough. The work is to cost $26,210. The dam will create in Lakes Temiskaming and Kippewa reservoirs for the conservation of waters for distribution during the summer months.

ORILLIA.—Mr. J. A. MacIlwraith will lay 20-inch cast iron pipe from the corner of King and Front Streets, into the pumping station, at 83c. a foot, the town to supply the pipe.

PORT ARTHUR.—Tenders for the construction and equipment of a power station in connection with Hydro-Electric Power Commission, to cost approximately $60,000, are in the hands of the commission and will probably be considered at an early date.

HAMILTON.—A new supplied wagon for the fire department will be furnished by J. D. Patterson & Company, for $165.

SARNIA.—P. Corrigan & Company, have been awarded a contract for the construction of the Durand Street sewer, at $6,927.73. Fred. Wales offered to do the work for $6,827.73.

TORONTO.—On page 521 of last week's issue we announced the award of contracts for 16 sixteen-inch stop valves and 2 check valves for water mains. The Canada Foundry Company were given the contract for the check valves at $74.27, while Mr. Matthew Warnoch received the order for 16 stop valves at $93.50 each. Other tenders were:—

| Stop Valves. | Check Valves. |
|---|---|
| $100.25 each | $130.25 each |
| 99.00 " | *125.00 " |
| 95.40 " | 81.41 " |
| 245.00 " | 75.00 " |
| 146.26 " | 85.00 " |

*Flange ends, $95 each.

TORONTO.—The City of Toronto received the following tenders for electrical apparatus for the waterworks, particulars of which were given on page 42, of the Canadian Engineer for October 15th:—

| No | Section "F." | Alternative "F. 1." | Altern'tive "F. 2." | Section "G." | Section "H." | "F.," "G." & "H." comb'd |
|---|---|---|---|---|---|---|
| 1 | 61,450 | Add $ 250 | Add $865 | 43,975 | 17,460 | ..... |
| 2 | 74,184 | Deduct 2006 | " 1,061 | 49,951 | 14,347 | ..... |
| 3 | 75,465 | " 7000 | " 1,000 | 50,170 | 16,585 | ..... |
| 4 | 56,319 | Add 2840 | " 1,695 | 40,674 | 13,257 | 107,756 |
| 5 | 83,036 | " 3422 | " 1,509 | 47,379 | 10,730 | 140,145 |
| 6 | 72,756 | " 2650 | " 1,350 | 48,100 | 16,060 | ..... |

It will be observed that only two tenders were submitted for sections "F.," "G.," and "H" combined, viz., tenders No. 4 and 5. No. 4, the tender of the Canadian Westinghouse Company was accepted. The next lowest tender for section "F." and "G." is No. 1, of the Dick, Kerr Company of England, submitted by the Canadian representatives—Chapman & Walker, Toronto. Tender No. 5, containing the lowest individual price on section "H.," is that of the Lancashire Dynamo & Motor Company of England.

TORONTO.—Contracts were awarded on Wednesday for eighteen pumps which will be installed in connection with the waterworks extensions. Section A, awarded to Jens Orten Boving, London, England, $14,800, was for four pumps with a capacity of 13,500,000 gallons each, for the main pumping station. The highest tender was $52,200. Section B, John McDougall, Caledonian Iron Works, Montreal, $11,703, was for two pumps with a capacity of 5,000,000 gallons, for the high-pressure fire system at the main pumping station. The highest tender was $35,000. Section C, Jens Orten Boving, $6,500, was for four pumps with a capacity of 16,000,000 gallons each, for the high-level pumping station. The highest tender was $24,000. Section D, John McDougall, Caledonian Iron Works, $7,385, was for four pumps with a capacity of 6,500,000 gallons each, for the high level pumping station. The highest tender was $18,400. Section E, Canadian General Electric Company, $4,822, was for four pumps with a capacity of 1,500,000 gallons each, for the Island pumping station. The highest tender was $14,500.

WESTON.—On page 522 last week we gave the names of the successful tenderers in connection with the waterworks here. This week Mr. George B. Maark was awarded the contract for the filtration basin, at $2,675. The unsuccessful tenderers were John F. Connoly, $2,900, and J. H. McKnight, $2,700.

**Saskatchewan.**

MOOSE JAW.—Coal for power plant contract was awarded to J. H. Wellington at $5.30 a ton f.o.b., Moose Jaw. Other bidders were: Pioneer Lumber Company, $5.10; Hitchcock & McCulloch, $5.10 and $6.05; McLean-Hodge Company, $5.40 and $5.35; C. W. Milestone, $5.40. All prices were f.o.b. cars, Moose Jaw, where all firms tendering are located.

## RAILWAYS.

**Ontario**

PORT COLBORNE.—It is thought that the construction of the electric line from Port Colborne to Welland will be completed by January.

OTTAWA.—The C. P. R. company will seek authority to build a line of railway from a point on its Pheasant Hills branch at or near Asquith, Sask., northwesterly for a distance of twenty miles.

SIMCOE.—A resolution was passed at a recent meeting of the town council to grant permission to Brantford-Port Dover Electric Railway to construct a line through the town of Simcoe.

TORONTO.—Word was received at the Toronto offices of the Grand Trunk Pacific this week that the section of the new line between Wainwright and Edmonton, Alta., will not be ready for through traffic till the spring. The road is in order, but the Railway Commission has refused to allow through trains to run, until the line has been properly fenced all the way. Contractors are rushing the work, but there are several months' work yet to be done.

FORT WILLIAM.—Master mechanics of the entire C. P. R. system held their annual meeting here on November 5th and 6th. Among those attending were representatives from the Atlantic to Pacific, including Vancouver, Calgary, Halifax, Montreal and Toronto. The meeting was held to discuss and devise ways and means for the betterment of the mechanical department.

PORT ARTHUR.—The C.N.R. will erect new sheds and a 40-stall round-house here.

**Manitoba.**

WINNIPEG.—The final location surveys for the Hudson Bay railway from the Pas Mission north are being pushed forward rapidly and at the present time 20 miles of the railway are ready for the contractors. No matter which terminal is selected on the bay, either Churchill or Nelson, the first 200 miles follow the same route, and it is expected that this will

be proceeded with in the spring. In the meanwhile plans for the bridge across the St. Boniface will be proceeded with and the contract for its construction will probably be let as soon as they are ready.

BRANDON.—It is stated here, on reliable authority, that the C.P.R. has decided to build a new line from Birtle to Brandon, via Hamiota, and that work will begin as soon as possible.

**Saskatchewan.**

PRINCE ALBERT.—A party of engineers and surveyors arrived in the city this week, completing the survey of the proposed line of the G. T. P. from Watrous, Sask., to Prince Albert. The party has been working on the survey for the last eight weeks and report that the new line will be easy to build. Watrous is 100 miles directly south of here and the proposed road will follow almost a direct route to this city. The line will cross the south branch of the Saskatchewan, eighteen miles from here and will follow along the south bank, entering the city and crossing the C.N.R. tracks at the roundhouse. It will be run parallel with the C.N.R. through the city, the route being surveyed along the edge of the hill.

**Alberta**

STETTLER.—Steel-laying operations are being carried on by the C. P. R. east of here, and it is expected that this section of the road will be completed shortly.

**British Columbia**

NELSON.—The immediate construction of an important stretch of railway in the Boundary country is announced. The portion of the line which will be built in the next three months will be a spur from Hartford Junction to the Athelstan and Jackpot mines of the Wellington camp. The contract for this section of line has been awarded by the C.P.R. to W. P. Tierney & Co. This will be the commencement of what will eventually be a 15 or 20-mile line, passing through one of the richest sections of the Boundary. On the completion of the three-mile stretch, the work will probably be carried forward to the remaining portion of the line.

## CEMENT—CONCRETE.

**Quebec.**

MONTREAL.—In connection with the reorganization of the Canada Cement Company the superintendents of the several mills have been retained as follows:—William O'Neil, of the International Company, at Hull, Irwin Kohler, of the Lehigh, at Belleville; D. M. Butchart, at Owen Sound; S. R. Preston, at the Vulcan; Fred Kilbourn, of the Lakefield at Montreal, and W. H. E. Bravender, at Calgary, and others in like position. Mr. A. C. Tagge has been appointed chief superintendent, and H. L. Doble, chief accountant of the company. H. A. Clarke is in charge of transportation, and other similar appointments will be made in a few days.

## LIGHT, HEAT, AND POWER.

**Quebec**

MONTREAL.—The second reading was given by the City Council to a by-law authorizing the corporation to establish a municipal lighting plant. The idea is that the city shall light the streets by utilizing the power derived from burning garbage.

**Ontario.**

PORT ARTHUR. — By a vote proportioned at almost three to one Port Arthur ratepayers decided to accept the agreement made with the Ontario Hydro-electric Commission for the delivery of power. The total vote was smaller than expected, standing at 425 to 169.

COLLINGWOOD. — This municipality will shortly install a producer gas plant. It is expected that the machinery will be shipped from the Old Country some time this week.

TRENTON.—Messrs. Moore & Scollan of 47 King St. West, Toronto, have been called in by the municipality of Trenton, to advise in connection with a by-law to grant a franchise to the Trenton Electric and Water Power Company.

PRESTON.—On Tuesday and Wednesday, October 26th and 27th, the engineers and others interested in the supply of Niagara power to various Ontario municipalities met in the council chamber of the town hall. Mr. R. A. Ross presided. The question of rates for lighting was discussed, but no decision was reached, and the matter will come up again at a meeting to be held in Toronto on November 16th and 17th. A law for the inspection of all electric wiring was recommended, and the Legislature will be urged to pass such legislation. Tenders on 13,000 volt insulators were received and accepted, and the secretary was instructed to write to the various municipalities and ask them to file their orders for equipment. The superintendent of the Galt, Preston, and Hespeler Railway furnished complimentary tickets to the engineers and invited them to visit the towns of Waterloo, Berlin, Preston, Hespeler and Galt which are reached by their railway. In the evening a banquet was tendered the engineers at the Delmonte Hotel.

**Manitoba**

WINNIPEG.—A recent report made by Smith, Kerry & Chace to the city council says that the contractors are making good progress on the civic power plant at Point du Bois. On the transmission line the concrete footings for towers are complete with the exception of about 12, between the Brokenhead river and Bird's Hill. About 25 footings in all have been put in. Forty-nine miles of telephone line have been completed.

**British Columbia.**

NELSON.—One of the most important private enterprises being carried on in the interior is that of the Bull River Falls Power & Light company in the Fort Steele district. An immense flume is now almost completed which will give at lowest water about 10,000 horse-power. The company proposes to supply light and power to all the towns in the Pass country from Michel and eastward to Moyie. A connection from the falls town with Jaffray by electric railway is also contemplated. This may eventually be extended to Fort Steele and Cranbrook.

## FINANCING PUBLIC WORKS.

**New Brunswick.**

ST. JOHN.—Bonds amounting to $6,500 will be issued by the municipality to cover the cost of laying water mains in Milford.

**Quebec.**

MONTREAL.—Until November 15th, tenders are invited by J. A. Gauthier, secretary of the Commission of Catholic Schools of Outremont, for an issue of debentures amounting to $50,000.

**Ontario.**

GUELPH.—Debentures aggregating $50,000 will probably be advertised for sale at an early date. The issue was sanctioned two years ago by the ratepayers, for Niagara power purposes.

**Manitoba.**

BRANDON.—A by-law to provide for improvements to the north approaches of the city, involving an expenditure of $10,000, is being considered by the City Council.

SWAN RIVER.—The ratepayers have carried a $15,000 by-law for the purchase of lighting plant, fire engine, weigh scales, etc.

## SEWERAGE AND WATERWORKS.

**Saskatchewan**

YELLOW GRASS.—The completion of the construction of the waterworks system, being installed by the town, is now in sight. The laying of the mains will be finished this week. The machinery for the pumping station at the supply wells is expected every day. The central power station is practically completed, and ready for operation.

**Quebec**

MONTREAL.—Mr. William Perry, hydraulic engineer, has just completed several interesting installations of waterworks machinery. These include a new plant for the Montreal Light, Heat & Power Company, pumping plant for the water supply of the Royal Victoria Hospital, and for Willetts, Limited, Chambly Canton, Que., a water supply delivering three thousand gallons a minute.

**Ontario.**

HAMILTON. — City Engineer Macallum is preparing plans for extensions to the waterworks system, to provide water for newly annexed districts of the city. Fire Chief Ten Eyck and the city engineer will also report on a scheme for fire protection which has been asked for by residents of the east end mountain top. The work of cleaning out the filtering basins has been completed.

WELLAND.—The city council have approved of the

water commission's scheme to build a new eight-inch main.

**Manitoba.**

BRANDON.—The sanitary committee have recommended the extension of the sewer outlet, and the city engineer will prepare an estimate of the cost of the work.

## PERSONAL NOTES.

MR. W. E. FOSTER has been appointed assistant solicitor for the Grand Trunk Railway, with headquarters at Montreal.

MR. G. E. MASON, of the Lancashire Dynamo & Motor Company, Trafford Park, Manchester, England, has opened an office in the Peterkin Building, Bay Street, Toronto.

MR. E. R. FARIBAULT, of the Geological Survey Staff, has accepted the post of Superintendent of Mines for the Quebec Government.

MR. WILLIAM MURDOCH, city engineer, of St. John, N.B., has also been appointed director of Public Works in that municipality.

MR. ALLEN WATERS succeeds Mr. N. H. Brydson as city engineer of Nanaimo, B.C. Mr. Brydson, it will be remembered was recently appointed assistant city engineer of Victoria, B.C.

MR. E. P. FEATHERSTONHAUGH, professor of electrical engineering in the University of Manitoba, was called in by the City of Winnipeg to give expert evidence with reference to the production of electrical energy used to operate the cars of the Winnipeg Electric Railway.

MR. A. F. TOWNSEND, for the past three years manager of the C. B. Electric Co., at Sydney, has resigned to take charge of an important branch office of Stone & Webster, in New England. Mr. H. C. Foss, of the S. & C. B. Railway Co., will succeed Mr. Townsend and will manage both Companies.

## OBITUARY.

MR. JOHN W. PATERSON, president of the Paterson Manufacturing Company, Toronto, died at Mobile, Ala., on November 6th, 1909.

MR. B. J. COGHLIN, of the B. J. Coghlin Company, Montreal, Que., died at Montreal November 10th, 1909. Mr. Coghlin was particularly well-known to the mercantile trade of Canada, being agent for some of the large steel rail firms, and also connected with the Montreal Spring and Axle Works.

## MARKET CONDITIONS.

Montreal, November 10th, 1909.

It would seem that the trade in pig-iron in the United States has shown some falling off since the first of November. Of course, the October trade was enormous so that the present lull does not mean that there is dullness, a large tonnage still changing hands. The tone of the market, however, is naturally a little less strong than previously and it might be that in some instances top figures are not being demanded. The volume of business in finished steel products is as large as ever. The main drawback to trade for the balance of this year, is the congestion at the mills. Apparently, some of the largest interests are now open to do business for delivery for the first quarter of 1910. Some 18,000 tons of fabricated structural steel have been contracted for already this month and there is enquiry for at least 60,000 tons more. Railway work has been conspicuous, but additional orders for rails and rolling stock are pending for 1910 delivery. In October, the merchant blast furnaces of the country made pig-iron at a greater rate than shown in any previous month in the history of the industry, although they barely passed the previous high record. At the same time, the steel works were making pig-iron at a rate of 3,000,000 in excess of their rate which made previous records in 1907.

There has been a considerable turn-over on the Glasgow pig-iron warrant market, this week. American cables, according to advices dated the end of October, were less bullish and the price of Cleveland warrants eased off, but later cables were better, and with few sales the price rose again about 6d. Shipments from Middlesboro continue to improve and the increase in store is consequently comparatively small.

In the local market the tone is steady, after the alterations of a week ago. Merchants seem to have a different view on the subject of steel plates, which were previously easy in tone, it being now considered that the market stands a very fair chance to advance within a short time. This remark applies to bars and structural steel and many other lines of finished and semi-finished products, the tone being firm throughout. Some merchants cannot quite understand why advances have not taken place before this, their belief being that there is no necessity to any longer accept the prices which have prevailed for such a long time past. The demand for pig-iron is apparently quite satisfactory and is fully up to production.

Following are this week's quotations:—

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90, imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.: ¼-inch, $4.90; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 4-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are firmer at $2.45 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per

"DESERONTO"
Charcoal Pig Iron
A. C. LESLIE & CO.
LIMITED
MONTREAL

100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32½ to 33c.

**Zinc.**—The tone is steady, at 6 to 6¼c.

* * * *

Toronto, November 11th, 1909.

In building materials of a universal kind activity continues. Bricks, broken stone, lime, sewer pipes, are all moving well; even cement is taking on a more satisfied tone since writers for the press have begun to demonstrate that the merger is going to be a blessing in disguise and will ensure a regular supply at a fixed price. The price of hard coal has advanced, as our quotations show, soft coal continues as before. Coke is higher, as a result of much increased activity in iron and steel output in the United States, and the supply is no longer abundant. Metals continue at last week's quotations, all iron and steel prices being firm.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady.

**Coal.**—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; canuel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.80.

**Copper Ingot.**—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite**, per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.50 per 100 lbs. Much is being now used for lumber camps.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $6.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.90; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.** Repeat quotations of last week, as follows:—Black, ⅛-inch, $2.25; ¼-inch, $2.25; ⅜-inch, $2.63; ½-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.80; 1½-inch, $7.80; 2-inch, $11.26; 2½-inch, $16.30; 3-inch, $21.52; 3½-inch, $25.00; 4-inch, $30.76, 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ⅛-inch, $2.86; ¼-inch, $3.68; ⅜-inch, $3.48; ½-inch, $4.43; ¾-inch, $5.62; 1-inch, $8.66; 1¼-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, $3 to $3.10; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60.

**Nails.**—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—Dealers report a large demand, the prices being as before, per catalogue

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10x16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1½ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—We do not alter prices as yet; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a good demand exists, and there is prospect of higher prices.

**Sheets Galvanized.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. Demand very active.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

## CAMP SUPPLIES.

**Beans.**—Hand picked, $2; prime, $1.85; Rangoon, $1.80.

**Butter.**—Dairy prints, 21 to 22c.; creamery rolls, 25 to 26c.

**Canned Goods.**—Peas, $1.00 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; corn, 75 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¼c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¾c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 9½c.

**Eggs.**—New laid, 25 to 26c. per dozen, in case lots.

**Lard.**—Scarce and higher. Tierces, 16c.; tub, 16¼c.; pails, 16½c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 75c. a bag.

**Pork.**—Market uncertain. Short cut, $27.50 per barrel; mess, $26, nominal; no stock here.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

(Continued on page 42).

# The Canadian Engineer

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## The Canadian Engineer

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## ACCIDENTS.

The question of ensuring the safety of life and limb is one that should enter into the engineer's design and the workman's execution. It is just as much a part of construction as of operation. No opportunity for increasing safety should be neglected. As man to man we owe this to our fellows, and on the plane of industrial conditions the prevention of accidents is a good investment.

The Fidelity and Casualty Company, of New York, in a recent publication, entitled "The Prevention of Industrial Accidents," points out with great emphasis that by far the larger number of accidents are due to negligence—negligence sometimes only by the one who suffers.

The absolute prevention of accidents is impossible; yet there is a wide field for work, and by inspection, legislation and co-operation the waste may be much reduced.

The employer has his part to do. He must provide suitable surroundings, pure air, sufficient light and plenty of room. A man working under good, healthy conditions will be less apt to blunder than the over-worked, crowded, sickly individual, with little interest in what he is doing or what he does.

The employer should also provide well-designed machinery, hoists, scaffolds, or whatever his men are working with or on. It is his duty to see they are working in guarded surroundings. They give their time and energy and thought to him—for a price. He does well to include in that price a care for their safety. He knows what is required of them, and will not allow a workman through ignorance to suffer. New men require careful instruction, followed by wise supervision. It may be all true that a man's value increases as the want of supervision decreases. But knowledge must be gained before the workman becomes careful and prudent. Sometimes he becomes an expert by imitation, sometimes by reflection and experience. But instruction is necessary.

## ENGINEER'S SKETCH BOOK.

Every engineer who aspires to advance in his profession should learn to sketch—all the better if he can sketch rapidly and with good taste. It is just as necessary for the engineer to be able to make an accurate, understandable sketch as it is for him to be able to write a good letter or furnish an understandable drawing.

Drawing is a universal language, in picture, in cartoon, in plan. It conveys ideas practically impossible with the spoken or written word.

Aside from the training that comes with the clear thinking necessary to produce a good sketch, the engineer is preparing a record which will preserve permanently the information he or his chief may require.

A good sketch will suggest ideas and furnish information at a glance that pages of written matter will not convey. It places the whole situation before the eye so that the mind may quickly grasp the idea.

A companion to the sketch book is the camera. We have in mind an exceedingly interesting and valuable report on an hydro-electric proposition, in which was incorporated a photograph of the power house site and a neat sketch of the power house and dam. It conveyed at once a good, general idea of the location, and gave some suggestions as to the possibilities of the scheme.

A sketch book and camera are almost as necessary to the engineer to-day as the chain and compass.

## EDITORIAL NOTES.

Last week the report of the Dominion Railway Board was laid on the table of the House of Commons by the Minister of Railways and Canals. In referring to accidents on Canadian railways, it gives a list of 438 persons killed and 1,201 injured during the year ending March 31st, 1909. Of the killed, 26 were passengers, 191 employees. The balance—almost one-half of the total—were trespassers. Truly, the public must be protected against their own folly. And yet when the railways prosecute, in the public interest, the trespasser, long and loud is the protest.

* * * *

The fearful, and, we trust, truly accidental catastrophe that occurred on a British Columbia electric railway recently is sure to raise the whole question of the operation of trains of cars on roads with very steep grades. We have Canadian electric roads hauling two, three or four cars of freight on grades as high as 10 per cent. and all the train crew located on the motor car. A following car breaks away, and there is no one to check it until much damage has been done. Ordinary good sense prevents the motorman following such a train from approaching very closely, yet there are many situations where his caution will not protect. Long grades, curves, obstructed view, and darkness, make it impossible for him to ward off all danger from runaway cars. Legislation should require efficient brakes and sufficient and properly located crews on all trains, whether the lines be trunk, urban, suburban or interurban. Only a kind Providence delayed so long such a fearful accident as that of last week. Let the warning be heeded.

## THE TRAINING OF AN ENGINEER.*

> "Once we fully grasp the fact that it is impossible in any university course to accomplish more than a part of the preliminary training of the engineer, and that the work of the university school is not to make engineers, but to fit men in the best way possible to become engineers, we find stress should be laid, in a college course, on principle and not on the innumerable details in engineering practice."

The text I have quoted is, I believe, a correct one; but the application thereof will lead to a wide variance of opinion. I think the engineering student should know his Arithmetic, Algebra, Geometry and Trigonometry, Analytical Geometry and Elementary Calculus, Applied Mechanics and Strength of Materials, Physics, Chemistry, Mineralogy and Geology, the rudiments of Metallurgy, Biology and Silviculture. He should have a sufficiently thorough acquaintance with English Literature and Language to be able to keep in touch with the best thought of the age. To this same end he should read Ethics and Natural Law, Psychology and First Principles of Knowledge, Political Economy, and have a rudimentary knowledge of Latin and Greek, and of at least one foreign language, preferably French. A knowledge of the Law of Corporations and Contracts and Real Property is also essential.

So far I have not dealt with much of a technical nature. His fourth year might be specifically devoted to Stresses in Structure, Design, etc. But the summer is the best time in which to familiarize him with practical work; the college cannot teach it, and ought not to try, in my view of the best course.

Of course, technical books are in use which cover the ground fully. Too much reliance should not be placed upon the formal lecture. I should require the student to get up his text and "quiz" him upon the work; the teacher would merely explain difficult points. The "quiz" not only brings out the student's ability to answer questions, but serves the more important object of training him to express correctly what he means. Incidentally, a "quiz" puts the entire class on the qui vive, and is the best means of impressing principles on the mind.

I think the teacher should select actual cases from time to time and place them before the class, requiring each student to work out his own solutions. In practice the problem, when it arises, is never before the practical man as a problem in Mathematics, Physics, or some other subject with a well-recognized source for solution, as is usual in the examples in the back of the text book. The data are all mixed up. Where am I to look for inspiration, to what branch of my studies does the matter belong? The thing needed is the educated mind. If I were to say there is too much instruction and not enough education, I should express about what I mean.

* M. J Butler, Deputy Minister of Railways and Canals and chairman of the Intercolonial Railway Commission, in "The University Monthly."

## COMING MEETINGS.

**American Society of Refrigerating Engineers.**—December 6. Annual meeting in New York City. Secretary, Wm. H. Ross, 154 Nassau Street, New York City.

**New Jersey Sanitary Association.**—December 3-4. Annual meeting at Laurel-in-the-Pines, Lakewood, N.J. Secretary, J. A. Exton, 75 Beech Street, Arlington, N.J.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton H. Moore, Butte, Mont.

**American Institute of Chemical Engineers.**—December 8-10. Annual meeting at Philadelphia, Pa. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

**American Association for the Advancement of Science.**—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

**American Society of Agricultural Engineers.**—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

**Association of American Portland Cement Manufacturers.**—December 14-15. Annual meeting at New York City. Secretary, Percy H. Wilson, Land Title Building, Philadelphia, Pa.

## METHOD OF CALCULATING HORSE-POWER.*

The engineer often finds it necessary to utilize an available waterfall or stream for power purposes. But before the wheels, turbines, or whatever method of developing the power, are installed, he must know the horse-power of the stream or fall.

The problem of calculating the horse-power of a waterfall or running stream is reduced to a simple formula, which any miner of ordinary intelligence can work out. It is based on the assumption that a horse-power is equal to 33,000 pounds lifted one foot per minute. This is the basis used in computing horse-power in any type of power developing machine. It is really more than the average horse is capable of, rather than less, as is generally supposed, the horse being able to lift only 22,000 pounds one foot per minute.

On this basis, however, that of 33,000 pounds lifted one foot per minute, the horse-power of a waterfall or stream is found by multiplying together the number of cubic feet of water which fall per minute, the vertical height or "head" in feet through which it falls, and the number, 62.3, this being the weight of a cubic foot of water in pounds; then divide the product of the whole by 33,000 Reduced to a formula, the problem appears as follows:—

$$\text{Horse-power} = \frac{\text{Cu. ft. per Min. x Vertical ht. ft. x 62.3 pounds.}}{\text{33,000-ft. pounds.}}$$

To better explain this formula, let an average case be supposed: Over a fall 20 feet high 1,000 cubic feet of water is discharged per minute. This problem would take the following simple form:—

$$\frac{\text{1,000 cu. ft. x 20 ft. x 62.3}}{\text{33,000-ft. pounds.}} = \frac{124{,}600}{33{,}000} = 40.71$$

horse-power.

It will be observed that to use this formula the miner must know the amount of discharges of the waterfall in cubic feet per minute. This, however, is not difficult to ascertain. By careful observations the cross-section area of the fall is learned and computed; this is then multiplied by the rate or velocity of the fall in feet per minute. This will give the number of cubic feet of water discharged per minute. In this, as in all other problems of like nature, the results are only approximate; but the main idea is to be as accurate as possible in making observations and securing data. It should be remembered that the formula itself is right; if errors occur, it must either be in the observations or in the final calculations.

The power of the waterfall will be developed by a breast-wheel, overshot, turbine or other type. But whatever the type, there must necessarily be considerable loss. Even though the miner has been careful in his observations, and has correctly calculated the horse-power by the above rule, he must allow for loss in the selecting of the wheels. Thus, an undershot realizes only one-fourth or, at best, one-third the actual power of the fall; a breast-wheel realizes one-half; an overshot wheel from two-thirds to three-fourths; a turbine from 0.75 to 0.87, and even as high as 0.90 of the fall, depending upon the skill of workmanship in manufacture and the manner in which it is installed. While an undershot or breast-wheel costs less to place, unless the miner has "water to throw away," it is far cheaper in the long run to place a good overshot wheel or a turbine.

Sometimes the miner wishes to utilize the power of a running stream, and would like to know how much it is capable of developing. To make these calculations it is presumed that the stream is confined at its point of proposed use to a flume of known dimensions. As the stream must be so confined before the water-wheel is placed, the estimates or figures for such conclusions will not be difficult to secure. About the only type of wheel that can be used in developing the power of a running stream is that with simple float-boards, instead of buckets or flanges. Thus, the wheel is driven by the ordinary or natural current of the stream without any appreciable fall like that in the preceding case. To apply the formula already given in calculating the water power of a running stream, the miner should first learn the virtual head, or rate of flow of the current. This is done by using floats, and by taking a number of observations between given points, "time" the speed of the floats and learn the velocity of the stream in feet per minute. Having thus found the head, the miner must next find the quantity of water which passes any given area of the stream in a minute. Thus, to use an average case, let it be supposed that the velocity or rate of flow of the stream is 250 feet per minute, and that the immersed part of the water-wheel float is 6 feet long and 1 foot wide or deep; then the area of the part of the wheel which receives the force of the current is 6 by 1, or 6 square feet. Hence, the formula for finding the cubic feet per minute would be in this case:—

6 sq. ft. x 250 ft. per min. = 1,500 cu. ft. per min.

The vertical height, or head of a running stream would virtually be the "grade" of the stream for a 10-foot section, or merely that portion used where the wheel is installed. In average cases this would amount to 0.19 or 0.2. Thus with the cubic feet of discharge per minute ascertained, and the head known, the miner will then proceed to find the horse-power by the formula given above for waterfalls. To use the case just cited, the results would be as follows:—

$$\frac{\text{1,500 cu. ft. per min. x 0.19 vert. ht. in ft. x 62.3 pounds.}}{\text{33,000 ft. pounds.}}$$

= 0.54 horse-power.

In a running stream, as in a waterfall, there is considerable loss when the utilization of its power be attempted. As but one type of wheel can be used, it is estimated that this loss in running streams is 0.6; that is, the wheel actually realizes only 0.4 the actual power of the stream. Hence, in the case just given the power developed would only be 0.54 by 0.4, or 0.216 horse-power. Multiplying this by 33,000 foot-pounds, it will be found that the wheel would be capable of lifting 7,128 foot-pounds per minute. But a rough allowance would still have to be made for friction of the journals, cutting the actual power of the wheel down to 7,000 foot-pounds per minute, which would be very close to what such a wheel, driven by a current of this velocity, head and size would develop.

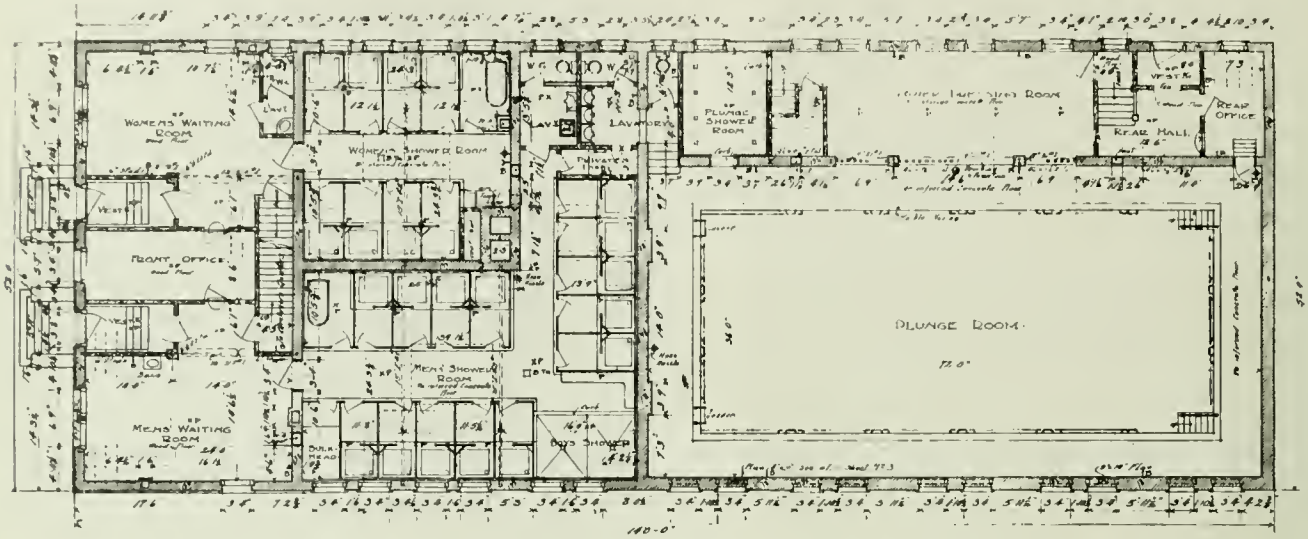
In measuring the velocity of a running stream, the miner should not make his calculations upon the surface speed of the current. The usual method, and that most likely to give average results, is to use a float which is submerged to a depth of one-half the width or depth of the wheel paddle; that is, if the paddle of the wheel dips into the water one foot, the float for estimating the velocity of the current should be submerged six inches.

*Abridged from an article by Dennis Stovall in The Mining World.

## HARRISON BATHS.

### Handsome Institution Recently Established by the City of Toronto.

A welcome innovation in the history of the city of Toronto was marked by the erection and the completion, this month, of a public bath-house.

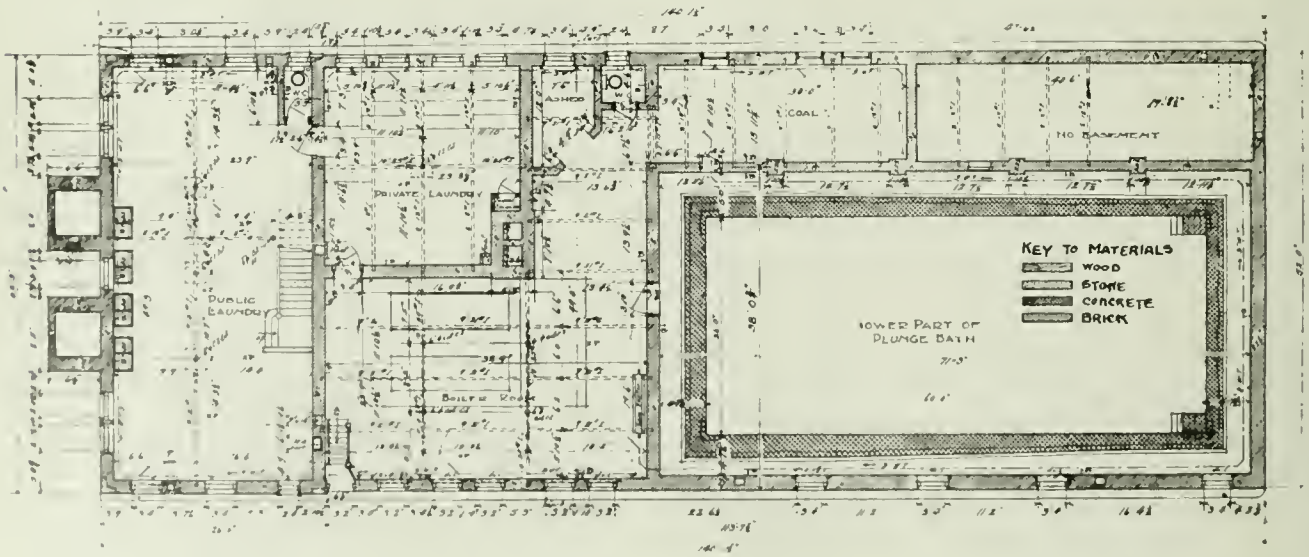



FIRST FLOOR PLAN

From the accompanying illustrations may be formed some idea of the structure, which cost $46,000, and has a frontage of 52 ft. 3 in. on the south side of Stephanie Place by a depth of 140 ft. 1½ in. It is of brick, stone, and concrete, the front portion for a depth of 26 ft. 6 in. being two-storey and basement, the balance one-storey and basement, but owing to the fact that the shower and plunge rooms are spacious and lofty, the elevation is practically uniform throughout.

Concrete was used exclusively in the construction of the swimming pool which was waterproofed with a water-repelling compound mixed at the same time as the concrete. The interior walls and divisions of the showers are of Italian marble, while glazed tiling is also extensively used. The floors are of reinforced concrete. A key to the materials of construction is given in the accompanying plan of the lay-out.

The operation of the institution is under the direct supervision of Mr. Roland C. Harris, the property commissioner, who, in 1906, investigated the question of establishing baths, and, in his report said:—"I cannot too strongly recommend the erection of a public bath house. When first instructed to look into the question, I regarded it largely as a philanthropic fad, but, after viewing its offices and work, was thoroughly imbued with the absolute necessity of its creation and existence."




BASEMENT PLAN

### Cost of Maintenance.

Appended is a reliable estimate of the cost of operating the plunge from 2 p.m. to 11 p.m. daily (Sunday excepted), and the showers from 9 a.m. to 6 p.m. daily, with the excep-

tion of the Sabbath, when the hours will be 9 a.m. to 12 noon:—

| | Rate per Annum. |
|---|---|
| Superintendent (with free living quarters, heat, light, water, etc.) | $ 700 00 |
| Female attendant | 500 00 |
| Instructor | 1,200 00 |
| One ticket seller | 624 00 |
| Three cleaners and attendants | 2,184 00 |
| 1st engineer | 1,000 00 |
| 2nd engineer | 900 00 |
| Coal, 400 tons at $6 per ton | 2,400 00 |
| Oil, repairs, etc. | 300 00 |
| Towels, soap, etc. | 300 00 |
| Lighting, power and gas | 800 00 |
| Miscellaneous | 500 00 |
| | $11,408 00 |

**Swimming Pool. Note Reflection in Water.**

The estimated cost of operating the baths sixteen hours daily, from 7 a.m. to 11 p.m., is $16,592 per year.

### Lay-out of Building.

The building, for practical purposes, is divided into two sections. The front portion with a depth of 66 feet, contains an office, separate waiting room for males and females, with lavatory accommodation. In the women's shower department are eight showers and one bath tub, the latter for aged and sickly people and infants. In the men's section are fourteen showers, tub and two gang showers for boys. The showers are of the non-scalding type—the cold water being first admitted to the mixer.

The rear section of the premises has a depth of 74 feet, and contains office, plunge room 72 ft. by 36 ft., locker rooms, lower and upper dressing rooms, balcony and plunge showers. The pool is 59 ft. long by 26 ft. wide, with a maximum depth of 8 feet and a minimum of 4 feet, and contains about 62,000 gallons of water, which is changed daily and kept at an approximately uniform temperature of 78 degrees Fahrenheit, by two 50 horse-power, horizontal return tubular boilers, built by the John Inglis Company, of Toronto. Each boiler is 48 inches in diameter, and 14 feet long, and contains 52 three-inch tubes. The shell of the boilers, which were designed to carry a working pressure of 100 pounds, is five-sixteenths thick, and the heads three-eighths.

In conjunction with the heating apparatus, "Tobey" heaters were supplied by The J. L. Mott Iron Works, of New York City.

There are one hundred lockers and two hundred bathers have been accommodated at one time. The public showers are absolutely free, and each patron is provided with soap and towel. A charge of ten cents is made for use of plunge. Each bather is provided with a towel, but must furnish his own bathing suit or trunks.

Before admission to the pool, every person is compelled to take a shower bath. The Corporation reserves the right to deny to any person the use of pool upon repayment of admission fee. In this way those filthy of person, and others suffering from skin diseases are debarred.

The City has retained a well known physical instructor to furnish lessons and advice to bathers, and the baths are daily increasing in popularity. During the first week they were used by nearly two thousand persons. On Saturday, November 6th, 795 used the plunge, while 304 used the showers.

The establishment of the baths is due to the untiring efforts of Controller Dr. William S. Harrison, from whose address at the formal opening we quote:—

"The way to cleanse the masses is to cleanse the individual, and to make a man clean in person is to inspire him with a desire for clean surroundings. Uncleanliness of person leads to toleration of filth and unsanitary conditions at home. A man with a clean and healthy body is more likely to have a clean and healthy mind, and one who respects himself is more likely to respect the rights of others. The public bath is local in effect but national in influence. A public bath is a working monument typifying the community's appreciation of civic health and cleanliness."

## MODERN ROADMAKING.*

**By W. W. Crosby, Chief Engineer, Maryland Geological Survey.**

Since the beginning of the first efforts for artificially constructing a road surface on which to travel repeatedly with animals or vehicles, man has been at work for centuries trying to put down "something which would stay put." The necessity for constantly and frequently doing over again something already done has been universally regarded as irksome and uneconomical. Certain results of use have been, temporarily perhaps, regarded as unavoidable and the restoration of these defects has been accepted with a certain amount of resignation by the majority of the workers. The futility of other common burdens has been generally recognized, but the bearing of them has frequently been accepted because the local conditions seemed to prevent their avoidance. The brighter minds and more progressive among the road workers have however, as to-day, recognized that the reduction of the burdens of road maintenance was a goal at which to aim and have laboured unceasingly and with much success towards it.

Improvements in connection were first made perhaps by the substitution of a stoned surface for that of the natural soil, with the object of avoiding, to some extent at least, the annoyance and expense of the more frequent attention required by the latter. This was followed by improvements in the methods of applying the metal that would not only result in a surface that such would prove more satisfactory from every point of view, but also would reduce the first cost. It should, of course, be clearly understood that main-

* Paper given before the Convention of Roadmakers at Columbus, Ohio.

tenance costs include a proper consideration of the initial expense or "investment," as well as the actual charges for performing the repairs themselves.

Possibly the erection of bridges and waterways came next in the line of progress and then improvements in the methods and the selection of materials for their construction.

Later was inaugurated such a consideration of the traffic and its resultant strains on the road as would tend to result in a permissible reduction in the amount of the "investment," without danger to the satisfaction with the result, and as would still further reduce the maintenance charges by a reduction in the factor of interest on the investment.

At the present time, the latter item is perhaps uppermost in the minds of highway engineers. A proper consideration of the amount and character of the traffic on a road is the basis for an accurate determination of the kind and amount of work to be done on it, and an essential also in this connection is an accurate record of the costs of repairs under known conditions of the locality, of the construction, and of traffic.

In 1907 the writer, after considerable investigation, was impressed with the unfortunate lack of knowledge on the part of highway engineers generally, concerning the amount and character of the traffic over those sections of modern roads where otherwise important conclusions might have been drawn because of the completeness of the records of the details of their construction, but from the lack of this information regarding traffic, where actually the most valuable conclusions were lost, and he then suggested in a published article the desirability of obtaining, and recording for the general benefit, detailed data of this sort. He desires here to express his cordial appreciation of the work that has since been done in this line by Messrs. Johnson of Illinois, Blanchard of Rhode Island, and by the Massachusetts Highway Commission and others, and to express his belief that the results of their work will be greatly appreciated by all highway engineers. Without just such data in connection with the records of the construction of the roads themselves, it would be impossible to prove the value of the methods of construction used, or the real value of the investment made, to say nothing of drawing a fair comparison in maintenance costs.

Just at this period, it seems to the writer that the profession of highway engineering is undergoing a greater transition than ever before. With the awakening of its importance as a branch of the science of engineering has come almost simultaneously a wonderful change in the traffic conditions to be met. It is to be regretted again that records of previous traffic conditions are not available for purposes of comparison, and the best that can be done now seems to be to secure without loss of time these records from such places as have experienced to the least extent the change mentioned.

Under the new traffic conditions, previously accepted standards seem to be unfit for following and new ones seem desirable. Many minds are at work on the problem and undoubtedly it will soon be solved. The writer believes that the solution will not only meet the new demands, but will also result in even greater economy than existed in many cases previous to the change in the traffic.

The writer wishes to call attention to what he believes an important point in this connection. He regrets the tendency apparent in some quarters to throw away, in view of the recognized agreement that even the best water-bound "macadam" is unfit for the new traffic conditions, all the carefully arrived at conclusions regarding its construction and to start entirely afresh with some, at least, new materials, ignoring the work of many years. He believes such a course most unwise and that there are still many of the old principles that should be firmly adhered to. Admitting the introduction of a cementing medium to the broken stone aggregate as necessary for modern work, it by no means follows that the original principles of proper foundation, sufficient drainage, etc., etc., can be ignored simply because of the presence of this cement. On the contrary, any departure from these fundamentals should be most carefully considered and only made continuously. The reduction to the minimum of the voids in the "metal" is as important now, if not more so, as ever before.

It may quite likely be true that the sizing of the pieces of metal may be advantageously modified to secure better results and to partially, perhaps, offset the cost of the introduction of the cement, but it is just as likely that even greater care will have to be exercised in the performance of the sizing. It is probable that readily available materials, heretofore excluded from use because of their lack, for instance, of cementing qualities, will be made available for the use of the cement, but it is also likely, as has been suggested by Secretary Fletcher of the Massachusetts Highway Commission, that even greater care will have to be exercised in the selection of the metal in order to provide for future traffic changes induced by the new road surface itself, and that materials heretofore successfully used will henceforth have to be rejected. Let us "hold fast to that which is good" and try to develop, rather than to attempt to create just at this time, and until the information referred to as desirable in the matter of traffic conditions, and new data now being collected concerning the character, use and results of the cement media, are available.

An apparent tendency, in certain instances, to abandon all previous conclusions as to construction methods and materials, and further to issue a dictum that future work should all be done along certain lines seems to the writer regrettable and inopportune. It seems to him that conclusions along general lines will be attainable in the near future, though of course it should go without saying, allowances will always have to be made for local conditions, but that in the meantime, much work will have to be done and a large amount of information from many sources will have to be secured.

## CONCRETE WEAKENED BY HEAT.

That the builders of reinforced concrete structures have room for some improvement in their methods, is evident from a report made by Mr. G. A. Stange, adjuster for a Chicago firm. It concerns a loss on the reinforced concrete building of F. B. Klock at South Elgin, Ill., used for the manufacture of drugs. The adjusters contended that the concrete floors and ceiling were not damaged sufficiently to be torn down, but the owner claimed that the concrete had been weakened by the intense heat, about 60,000 pounds of drugs having burned.

It was decided to test the building by putting a weight of 400 pounds to the square foot on the panels, which were to be held defective if they deflected more than 3-16 of an inch, that being the original test made by the architect when the building was turned over to the owners. Tests were made of eight panels involved in the fire, all of them showing considerably more than 3-16 of an inch deflection with only 250 pounds weight to the square foot. When the same weight was applied to panels in other portions of the building not affected by the fire the deflection was less than 1-10 of an inch. In consequence a total loss was allowed on six panels and a compromise on two.

The adjusters hold that had the building been of any other construction than concrete it would have been totally destroyed, owing to the tremendous heat engendered by the drugs burning. The expansion of the reinforced steel under the intense heat is believed to account for the weakening of the concrete.

THE
# Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWAGE SLUDGE AND SEPTIC ACTION.

The Canadian Engineer of December last year published a review of the fifth report of the Royal Commission on Sewage Disposal, in which the following statement relative to septic tank treatment was made: "The conclusions of the Royal Commission appear to point to the advisability of some improvement to the septic tank as now used. The only point in its favor in comparison with other methods appears to remain in the fact that a percentage of the sludge is dissolved by putrefaction and hydrolysis. The main point against the system is that the 'liquor' is not constant, and that the suspended solids in the effluent increase in the event of the sludge being allowed to collect. This suggests that if it is desirable to eliminate sludge by putrefaction, then the putrefactive process should take place apart from contact with the liquid sewage. This might be done by withdrawing the precipitated sludge immediately from the sedimentary tanks into other tanks built specially for its reception, in which septic action could be carried on for any length of time desired without affecting the effluent liquor."

Those who have been following recent published literature on the question of dealing with sewage solids will have noted that the whole tendency in improved methods has been in the direction of the immediate removal of settled solids from contact with the supernatant liquor.

No doubt appears to remain as to the fallacy of the claim of total sludge elimination by septic action; and that the reason why the level of settled sludge becomes stationary after obtaining a certain depth is simply explained by the now understood fact that solids practically equal to the amount in the incoming sewage pass out of the tank in finer divided particles. Further, it is also acknowledged that the gradual increase of solids in the tank effluent is due to the effervescent septic action, the rising of the gas bubbles carrying back into the liquor the solids in fine particles.

Hence, the problem of separating the putrefying settled solids as rapidly as possible from the liquid forms the most important feature in modern methods of removal of solids.

In last week's issue of the Review we published in full a paper read before the British Association of Municipal and County Engineers by Mr. James P. Norrington, C.E., entitled "Some Notes on the Separation of Solids from Sewage and Waste Liquors." This paper has been widely discussed and remarked upon, both in Great Britain and the States.

The paper chiefly describes the German Kessel tank. This tank is on the same principle as the Dortmund tank, as far as sedimentation is concerned; but a new feature is introduced, inasmuch as the tank is fixed above the level of the inflowing sewage, syphon action being arranged, so that the sludge is removed at a level of from two to three inches below the level of the inflowing sewage, no pumping being required.

The sludge is continuously removed from the tank by aid of its specific gravity being greater than water, while floating matter is drawn off by an ingenious device. A sludge deposit chamber is constructed entirely apart from the tank, and the solids once removed cannot regain contact with the liquor.

A second form of tank (rectangular) is also described in which the total capacity of an effective plant may be kept down as low as half an hour's flow of the maximum volume to be dealt with. The writer of the paper refers to the installation of this type of tank at Dorchester, where at least 25 per cent. of the total volume of sewage is brewery refuse. The proportion of suspended solids removed from the crude sewage in this manner is as high as 96.5 per cent.

The writer states: "The principal involved in both these types of separators is that, after the water has done its work of transporting the polluting solids from the house to the spot where they can be dealt with, the sooner it is separated from the sewage solids the better."

In this connection it is interesting to note that the above principle has been acted on in connection with the proposed separator tanks for the Toronto sewage outfall works. It will be remembered that the consulting engineers, Messrs. Watson, of England, and Hering, of New York, recommended that the sludge be removed daily by means of electric pumps, and be conveyed away from the separator tanks to a spot where putrefactive action could take place without affecting the flowing liquid.

The recognition of the principle that septic action in sludge should take place apart from the action of sedimentation will have a practical effect on the size and design of separator tanks. Referring to an article in this Review of May 14th (this year) dealing with the removal of solids, this question is fully dealt with on the basis of Steurwagel's experiments on sedimentation of solids, in which from one to two hours' capacity flow is all that is shown to be required for the tanks. It is usual to build septic tanks of capacities equal to from twelve to twenty-four hours' flow of sewage, and it appears that the only result obtained from these tanks is that the sewage is passed over a large area of putrefying and fermenting sludge, which cause the effluent liquid to take up an amount of solids in fine particles about equal to the volume of heavy solids which have settled from it in its passage through the tanks. In effect, practically, the sewage, although apparently, is no purer than at its

entrance to the tanks, and is chemically in a condition which makes it very difficult to oxidise on filter beds as compared with fresh sewage liquid.

For the past few years great attention has been given to the purification of the liquid sewage by nitrification, and it is now being recognized on every hand that the successful purification of the liquid sewage depends almost entirely upon the immediate and rapid removal of the solids from contact with the fresh liquid sewage.

## THE COST OF CLEARING WATER IN SETTLING BASINS.*

By S. Bent Russell,† M. Am. Soc. C.E.

We find that the settling basin may not readily be dispensed with, in preparing surface waters for municipal use. In many cases the settling basin seems to be in competition with filtration as a means of making city water satisfactory. In other cases we find the settling basin an important part of the modern filtration plant. Moreover, in mechanical filter plants the tendency seems to be that more work shall be done in the settling basin and less in the filter. This brings up a desire for more information as to the cost of treating water by the simple method of settling.

We find, however, that it is not easy to formulate rules for estimating the cost of settling water. The cost of pumping and of filtering water may be estimated when the quantity and lift are known. The cost of settling basins, however, would seem to depend more upon local conditions. In this paper your attention is directed to the factors that enter into the cost of settling water and certain data from existing waterworks will be given that will be of assistance perhaps in making rough preliminary estimates.

In the general problem before us we have, besides the factors that enter into the cost of settling proper, the dependent factors, loss of head and repumping. We must also consider certain balancing advantages attendant upon repumping, etc.

When a river is the source of supply the use of settling basins usually involves repumping the entire quantity of water as it is more economical to have the basins near the intake. In some cases the two pumpings may be at one combined plant, but it will often be better to have two pumping plants connected by a low pressure or gravity conduit. The saving on the conduit will go to make up for the duplication of pumping plant. If a loss of head is allowed in the basins, they can be used for storage. This will give an advantage in case of damage to the intake or of ice stopping the supply. Moreover when basins at the intake are used, high pressure engines can be more favorably placed for economical maintenance, and we may note here that pump valves for high pressure will last longer with settled water. Another important saving is from keeping mud and grit out of our pump mains and distribution pipes and meters, and this saving should offset part of the cost of settling the water.

If the settling is to be followed by filtration, we find a saving in both first cost and in operation of the filters as a result of the sedimentation in a large majority of cases. In small plants it may be desirable to run the river pumps only part of the time each day. In such a case basins for combined settling and storage will be profitable.

Let us suppose that we have a river pumping station and a high pressure pumping plant supplying the town, so connected that settling basins may without complication be placed between them. How much will our expenses be increased by the improvement? Although our problem is now greatly simplified, we still find it quite a complicated one and determined by local conditions. The daily quantity to be handled and its rate of increase, and the character and amount of sediment are important. The kind of soil and rock, climatic and flood conditions, drainage, kind of building material available, cost of land, etc., must be considered. The operating organization of the waterworks and financial conditions must be reckoned with. We must know whether coagulants are to be used or not. A coagulating plant may be considered as auxiliary to the settling basins.

We may assume that the basins can be operated with or without loss of head and consequent extra lift by the pumping engines. The cost of settling may be divided into the following items: Interest, depreciation, repairs, operation, clearing, increased lift, pumping cleaning water, coagulating, pumping for coagulating plant, and ground rent. The item of coagulating may, of course, be subdivided into similar heads.

Let us take up some of the above items separately. Interest on first cost will usually be the most important item. Four types of settling reservoirs may be considered: (I.) basins formed by damming a natural valley; (II.) earth embankment basins; (III.) masonry walled basins; (IV.) covered reservoirs.

Reservoirs built for settling will usually cost somewhat more than service reservoirs of the same capacity and type on acconnt of provisions for cleaning and special connections and for baffle walls, weirs, etc. The cost of service and storage reservoirs, however, may be taken as a guide. Table I. gives the cost of a number of reservoirs and the cost per million gallons capacity. The Sudbury reservoirs are included as a matter of interest although they are not paved and are not of a type that could be used for larger proportions of sediment. A covered reservoir is also given although settling basins will seldom need to be covered.

At a meeting of the British Association of Waterworks some years ago, Mr. W. Ingham (see files of water and gas reviews) stated that a covered reservoir of 300,000 gallons capacity had been built for £5 10s. per 1,000 gallons capacity. This would in our units be about $22,900 per mililon United States gallons. Mr. Ingham also gave the following analysis of the cost of reservoirs:—

**Open Reservoirs.**

| | | | | |
|---|---|---|---|---|
| Excavation | 15 | per cent. | of total | cost. |
| Floors | 35 | " | " | " |
| Walls | 50 | " | " | " |

**Covered Reservoirs.**

| | | | | |
|---|---|---|---|---|
| Excavation | 10 | per cent. | of total | cost. |
| Floors | 24 | " | " | " |
| Walls | 28 | " | " | " |
| Roof | 38 | " | " | " |

While discussing the first cost let us anticipate a bit and assume that the total charges for running a system of basins is 8 per cent. of the first cost. Then if the basins cost $1,000 per million gallons' capacity, the expenses would be $\frac{1{,}000 \times 8}{100 \times 365}$

* From a paper before the Convention of the Central States Waterworks Association, Columbus, Ohio, Sept. 28.

† Consulting Engineer, 415 Locust Street, St. Louis, Mo.

$0.219 per million per day, i.e., a million gallons can be stored one day for 21.9 cents. If the basins cost $5,000 per million gallons the storage costs $1.095; if the cost is $10,000, it costs $2.19 per million gallons per day.

The item of depreciation is dependent on the life of the plant. Now a reservoir is like a baby's shoe—it is usually outgrown before it is outworn. As a basis for depreciation we must estimate how long the reservoir will prove useful to the municipality.

Repairs should be but a small item. Large repair bills usually point to faulty construction.

The cost of operating depends in some degree upon the size of the plant and upon the quantity of water passing through. The cost should be greater with intermittent flow than with constant flow. In many plants the cost will be inconsiderable.

The cost of cleaning is dependent upon the quantity of water handled and the proportion of sediment removed. The area, or dimensions, of the floors will influence the cost. The inclination of floors and drains, etc., are important factors, and the character of the sediment must be considered. This item is of some importance, where there is much sediment, and to keep this cost within proper limits we are justified in adding considerably to the first cost of the plant. In the years 1900 and 1901 the Compton Hill service reservoir at St. Louis was cleaned under the direction of the writer. About 27,000 cubic yards of mud were removed from one basin. Owing to the flatness and roughness of the floor and lack of proper facilities this work cost about 7.5 cents per cubic yard.

| | Class |
|---|---|
| Boston, Sudbury, No. 2 | I. |
| Boston, Sudbury, No. 4 | I. |
| Boston, Sudbury, No. 6 | I. |
| Cincinnati | I. |
| Harrisburg, Pa. | II. |
| Minneapolis, Minn. | II. |
| St. Louis, C. H. | II. |
| Cincinnati, O. | II. |
| Cincinnati, O. | II. |
| St. Louis, B. P. | III. |
| St. Louis, No. 1-6 | III. |
| St. Louis, No. 7-8 | III. |
| St. Louis, Baden | III. |
| Coshocton, O. | IV. |

| No. of basins | Total capacity million gallons | Cost | Cost per million gals. capacity | |
|---|---|---|---|---|
| 1 | 5?0 | $ 71,472 | $ 135 | |
| 1 | 1,400 | 813,846 | 570 | Soil stripped |
| 1 | 1,530 | 910,300 | 600 | Soil stripped |
| 2 | 330 | 1,276,000 | 3,865 | Settling |
| 1 | 4 | 21,485 | 5,371 | Settling |
| 2 | 93 | 442,328 | 4,750 | Service |
| 2 | 60 | 271,671 | 4,528 | Service |
| 3 | 22 | 206,300 | 9,170 | Settling |
| 1 | 19 | 136,500 | 6,970 | Storage |
| 4 | 65 | 578,437 | 8,000 | Settling |
| 6 | 168 | 1,021,087 | 6,080 | Settling |
| 2 | 80 | 523,609 | 6,545 | Settling |
| 1 | 50 | 250,066 | 3,126 | Storage |
| 1 | 0.320 | 4,310 | 13,470 | Service |

In that same year 233,126 cubic yds. were removed from the settling basins at the Chain of Rocks reservoir for 1.017 cents per cubic yard, or less than 1/7 of the cost at Compton Hill. This difference is partly on account of the greater inclination and smoothness of the floor of the basins and better waste-pipe connections.

The item for increased lift will depend mainly upon the cost of fuel, on the daily quantity of water and on the class of pumping engines.

The amount of water wasted in cleaning basins will depend on the effectiveness of the design, on the character and quantity of sediment, etc. In the years 1885-1888, about twelve cubic yards of mud per million gallons supply were washed out of the St. Louis basins. Some notes by the writer show that for the new basins at the Chain of Rocks, Nos. 1-6, where no coagulant was used, about 100 gallons of water were required to wash out 1 cubic yard of mud. This would indicate that under similar conditions 1,200 gallons per million would be wasted for cleaning basins. This would amount to about 1 1/2 per cent. per million gallons for pumping, which is inconsiderable.

It is a matter of interest to note the following items in regard to coagulation at St. Louis: For the year ending April 1909, the cost of coagulating was $3.03 per million United States gallons, divided as follows:

| | |
|---|---|
| Lime | $1.740 |
| Sulphate of iron | 1.532 |
| Labor | 0.622 |
| Power | 0.086 |
| Repairs | 0.010 |

These figures do not include pumping for coagulating plant nor fixed charges. Since that time a new coagulating plant has been built, in which modern elevating and conveying machinery with automatic controlling devices is used. It is designed to operate with a smaller force of men than the old plant. The contract price for the building with conveying machinery was $80,500. This did not include all the machinery. If we take interest, depreciation, and insurance at 10 per cent., and assume 100,000,000 gallons per day, we would have 24.4 cents per 1,000,000 gallons treated.

The amount of water that must be repumped for coagulating will depend upon the design of the plant. As a matter of interest we may note that in the Cincinnati plant for the year 1908, with an average of 44,000,000 gallons treated per day, about 1,00,000,000 gallons per day is drawn from the settling basins through the lime saturators, while 1.5 cubic feet per minute of filtered water is used for slaking lime and 2.5 cubic feet per minute for dissolving sulphate of iron.

The last item on our list is ground rent. It will be, of course, in some degree proportionate to the size of the plant, but will also be determined by conditions that are local.

If now we add up the estimates made for the items given, the sum will be the cost of settling proper. This cost without coagulation will not be strictly proportional to the first cost of the plant, but it seems probable that it will be nearer to that than to a value in proportion to the volume of water treated.

The best information to guide us will be the records of waterworks that have used settling basins for a long time. Tables II. and III. are compiled from the records of the St. Louis Waterworks, and cover the period of use for settling of the basins at Bissell's Point. They were installed in 1871, and were used for treating the city supply for twenty-four

years, after which and to the present time they have been used for storage of clear water. Table II. shows the expenditures each year for the last fifteen years of settling, and the average daily consumption of water in million gallons.

**Table III.—Cost of Settling Water, Bissell's Point Basins, St. Louis, 1881-1894.**

| | Cost per million gallons settled | Cost per year in per cent. of first cost | Cost in per cent. of coal bills, low duty plant* | Cost in per cent. of coal bills, high duty plant† |
|---|---|---|---|---|
| Interest | $2.82 | 5. | 47.5 | 113. |
| Depreciation | .70 | 1.4 | 13.4 | 32.0 |
| Repairs | .054 | .068 | .92 | 2.17 |
| Operating | .281 | .34 | 4.72 | 11.25 |
| Cleaning | .198 | .23 | 3.35 | 7.90 |
| Increased lift. | .329 | .585 | 5.6 | 5.6 |
| Total | $4.472 | 7.623 | 75.49 | 172.01 |

**Average Daily Consumption of Water in Millions of United States Gallons.**

| Year | 1871 | 1872 | 1873 | 1874 | 1875 | 1876 | 1877 | 1878 | 1879 | 1880 |
|---|---|---|---|---|---|---|---|---|---|---|
| Daily Av'g. | 12.9 | 14.5 | 16.4 | 17.9 | 20.1 | 20.9 | 22.3 | 23.0 | 25.0 | 25.1 |

In 1882, the first repairs of magnitude after installation were made. In 1889 leaks and breaks were repaired. In 1890 joints were repointed and the coping was dressed. In Table II. the cost of coal for pumping for the last 10 years is also given for comparison The 8th column gives the cost of coal for pumping with a lift of about fifty feet from the river to the basins. The seventh column shows the cost of pumping the clear water into the city distribution system with a lift of about 200 feet.

There were four basins, each of about 16,225,000 gallons storage capacity. They were designed for a consumption of about 30,000,000 per day with a quiet settlement of about twenty-four hours. They were operated on the intermittent flow, or fill and draw system. The head lost was about fourteen feet. Provisions for cleaning were fairly good.

Table III. shows the cost of settling water at the old Bissell's Point basins, expressed in four different ways. The first cost of the settling basins was $578,500 and the interest was arbitrarily taken at 5 per cent. The annual depreciation was figured in the following manner: The basins were intended to do for a consumption of 30,000,000 gallons per day, but as the average rate of using is always less than the maximum for a growing plant making extensions from time to time, a rate of 28.1 million gallons has been taken, and as for the first years of use the rate was very small, it was thought that the service was equivalent to twenty-one years at 28.1 million gallons per day. An annuity of $2.80 at 5 per cent. will redeem $100 in about twenty-one years. For salvage, 50 per cent. of the cost of the basins was taken off, as it was considered that the basins are worth for storage purposes one-half of the orginal cost. This gives us an annual depreciation of 1.4 per cent.

In the third column of Table III. we have each item expressed in annual cost per cent. of first cost. This disregards the quantity of water handled. The footing for this column shows 7.623 per cent. To this we may add 0.28 per cent. for rental of land, and get 7.9 per cent. as the total annual charge. It might be well to add a small charge for accident insurance to provide for damage by earthquakes or other calamities. Therefore we might say that to run settling basins like those used at St. Louis from 1871 to 1894, would cost in round numbers about 9 per cent. per annum of the first cost.

In the fourth column of Table III. the cost is expressed in per cent. of the cost of coal used for pumping for both the river and the high-lift pumps. This is given because the cost of pumping will serve as a familiar yardstick for waterworks men. The footing shows that the cost of clearing the water was about 75 per cent. of the cost of coal used for such pumping. The pumping engines used were of low efficiency. In the last column of Table III. the cost is compared with coal for pumping if engines had been used of as high efficiency as those now in use at the St. Louis waterworks. The footing of this column shows that the cost of clearing the water was nearly 75 per cent. higher than the cost of coal. These values do not include any allowance for rental of land nor for accident insurance.

**Table II.—Cost of Settling at Bissell's Point Basins, St. Louis, Mo.**

| Year | Pay Roll | | | Materials | | Coal per million gallons | | |
|---|---|---|---|---|---|---|---|---|
| | Operating | Cleaning | Repairs | Repairing | Daily consumption | High service | Low | Total |
| 1881 | $ 2,588.00 | $ 1,405.48 | $ 245.00 | ..... | 27.5 | ..... | ..... | ..... |
| 1882 | 2,400.00 | 2,875.00 | 1,259.57 | ..... | 28 | ..... | ..... | ..... |
| 1883 | 2,400.00 | 1,876.71 | ..... | ..... | 27.5 | ..... | ..... | ..... |
| 1884 | 2,417.50 | 2,034.00 | 341.60 | ..... | 24.8 | ..... | ..... | ..... |
| 1885 | 2,400.00 | 3,276.00 | 185.56 | ..... | 26.9 | $4,885 | $1,738 | $6,623 |
| 1886 | 2,400.00 | 2,105.36 | 187.93 | ..... | 30.5 | 4,600 | 1,889 | 6,489 |
| 1887 | 2,448.56 | 2,137.50 | 26.17 | ..... | 30.5 | 4,442 | 1,934 | 6,376 |
| 1888 | 2,449.11 | 1,865.41 | 560.17 | $ 157.78 | 32.7 | 4,375 | 2,345 | 6,720 |
| 1889 | 3,991.25 | 2,927.35 | 908.30 | 129.83 | 32.3 | 3,850 | 1,904 | 5,754 |
| 1890 | 4,020.00 | 1,386.00 | 1,139.63 | 334.88 | 35.2 | 3,462 | 1,763 | 5,225 |
| 1891 | 4,020.00 | 1,411.20 | 1,233.56 | 468.69 | 38.6 | 3,298 | 1,587 | 4,885 |
| 1892 | 4,028.00 | 2,286.26 | 36.67 | 397.16 | 42.1 | 3,484 | 1,830 | 5,314 |
| 1893 | 4,319.97 | 2,810.89 | 170.55 | 629.74 | 47.5 | 3,805 | 1,969 | 5,774 |
| 1894 | 4,617.99 | 3,519.19 | 171.95 | 809.10 | 52.9 | 3,779 | 2,041 | 5,820 |
| 1895 | 4,588.26 | 2,688.20 | ..... | ..... | ..... | ..... | ..... | ..... |
| Total | $40,088.64 | $34,694.55 | $6,466.66 | $2,927.18 | 477.0 | | | |
| Average | | | | | | $3,998 | $1,900 | $5,898 |

* Figures based on actual cost of coal used.

† Cost of coal taken at 42 per cent. of the actual cost as the cost if the engines had been as economical of fuel as those now in use.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

8540—October 15—Approving plans and specifications of the municipal corporation of the Township of Colchester, North Ontario, re Pinkerton Drain, under lands and tracks of the M.C.R.R. between lots 14 and 15 in 13th concession in said township.

8541—November 3—Granting leave to the Montreal & Southern Counties Railway to open for the carriage of traffic portion of its railway extending from its terminus at Youville and McGill Streets, Montreal, P.Q., to St. Denis Street, town of St. Lambert, P.Q.

8542—November 2—Granting leave to the M.C.R.R. to construct, maintain, and operate spur track to the premises of the Postum Cereal Company, Windsor, Ont.

8543—November 3—Approving and sanctioning location of C.N.O. Railway Company line through Townships Pickering, Scarborough, and York, Ont.

8544—November 3—Granting leave to the C.P.R. to construct its railway siding across the public crossing near Mc Adam Junction, N.B.

8545—November 3—Approving and sanctioning change of location of the V. V. & E. Railway & Navigation Company branch line from Sapperton and Fraser River Lumber Company, B.C.

8546—November 3—Authorizing the G.T.R. to construct, maintain, and operate branch line to and into the premises of the Noxon Company, Limited, Ingersoll, Ont.

8547 to 8552 Inc.—November 4—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at Myrtle Station, Ont.; T. H. & B. Railway, Irondale, Ont.; C.P.R. Tel. line 1½ miles north Warden Station, P.Q., Orangeville Station, Ont., ¼ mile north of Warden Station, P.Q., and the M.C.R.R. at Hewitt Station, Ont.

8553—November 4—Granting leave to the Tuckersmith Municipal Telephone System, to erect, place, and maintain its wires across the track of the G.T.R. at the side road between the 1st and 2nd concessions of the Township of Stanley, County Huron, Province Ontario.

8554—November 3—Granting leave to Eugene Danis, to erect, place, and maintain wires across the track of the C.P.R. at Lacoste public crossing between mile posts 96 and 97, Lacoste, P.Q.

8555—November 3—Authorizing the corporation of the city of Ottawa, Ont., to lay and thereafter maintain tile pipe sewer under the track of the C.P.R. on Yonge Street, Ottawa, Ont.

8556—November 4—Granting leave to the M.C.R.R. to operate its train over, upon, and through the connection with the G.T.R. at Bathurst Street, London, Ont.

8557—November 3—Granting leave to the Markham & Pickering Telephone Company, Limited, to erect, place, and maintain its wires across the track of the G.T.R. where the same intersects the side road between Lots 15 and 16, 8th concession, Township Markham, Ont.

8558—November 3—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for F. Gobeille, at Mile End Station on said railway.

8559—November 3—Authorizing the C.P.R. to construct, maintain, and operate branch line or spur, across Ave. "D" and across Lot 38, Block 3, in town Saskatoon, Sask., for Saskatoon Tent & Mattress Company, Limited.

8560—November 3—Authorizing the G.T.R. Company to construct maintain, and operate branch line to and into the premises of T. E. Manley Chew, across Old Sturgeon Bay Road, Township Tay, Ont.

8561—November 4—Granting leave to the C.P.R. to construct two extra tracks across Third Avenue in town of Pincher, on its Crow's Nest Pass Branch, Alberta.

8562—November 4—Granting leave to the Government, Province Saskatchewan, to construct a highway crossing over the right of way of the C.N.R. Company adjoining the east end of the station grounds in the N.E. ¼ Sec. 5, Tp. 44, R. 16, west 3rd Meridian, Saskatchewan.

8563—November 4—Granting leave to the Orford Mountain Railway Company to deviate public crossing across its track on Lot 23, R. 7, Tp. Melbourne, County of Richmond, P.Q.

8564—November 3—Extending for a period of one month the time within which the V. V. & E. Railway & Navigation Company were directed to install interlocking plant required to be provided by Order No. 7478, dated July 6th, 1909, to the Fraser River Lumber Company at New Westminster, B.C.

8565—November 3—Authorizing the C. W. & Lake Erie Railway Company to construct, maintain and operate branch line of railway, or spur, on several streets in the city of Chatham, Ont.

8566—November 3—Authorizing the C.P.R. to change its line of railway at Ste. Agathe, P.Q., and to remove its station buildings.

8567—November 3—Granting leave to the Hydro-Electric Power Commissioner of Ontario, to erect, place, and maintain its transmission wires across the track of the C.P.R. on part of Lots 12 and 13, B. F. To. of North Oxford, Ont.

8568—November 3—Granting leave to the Hydro-Electric Power Commission of Ontario to erect, place, and maintain its transmission lines across the track of the C.P.R. at Lot 35, Con. Gore, Township of Puslinch, County Wellington, Ont.

8569—November 3—Granting leave to the municipality of the corporation of the city of Calgary, Alta., to erect, place, and maintain, at its own expense, its electric light and power wires across the main line of the C.P.R. at 15th Street, Calgary, Alta.

8570—November 3—Granting leave to the Nipissing Power Company, Limited, to erect, place, and maintain its transmission lines across the track of the G.T.R. at Callander, Ont.

8571—November 3—Granting leave to the Nipissing Power Company, Limited, to erect, place, and maintain its transmission lines across the track of the G.T.R. at Nipissing Junction, Township Ferris, Ont.

8572—October 29—Rescinding Order of the Board No. 5907, dated December 23rd, 1908, authorizing the G.T.P. Railway to construct a bridge between Watson's Island & Kaien Island, B.C., the Government of British Columbia objecting to the same.

8573—October 27—Authorizing the Vancouver & Lulu Island Railway Company to cross Grenville Street in municipality of Pt. Grey, with the tracks of a branch line of its railway, B.C.

8574—October 27—Authorizing the C.P.R. to construct branch line to the warehouse of the Great Northern Transfer Company, Vancouver, B.C.

8575—October 27—Approving and granting leave to the V. V. & E. Railway Company to join its tracks with the

(Continued on page 575).

## CONCRETE TRUSS BRIDGE: THE FIRST IN CANADA.*

The architect says with truth of the bridge engineer that he aims only at results which are useful and scorns the beautiful. The general form of a steel truss is often decided upon with no thought of æsthetic design, and a few dollars afterwards spent on ornamental railings or other details will never remedy the defect. And yet mathematics and æsthetics go hand-in-hand, and a simple steel truss with the upper panel points lying on the singularly graceful curve, the common parabola, can be designed with more economy of material than the unsightly steel truss with parallel chords. If the cost of the former would be greater under present conditions, then shop practice and facilities are principally to blame.

**A Concrete Truss Bridge on the Middle Road, between the Counties of York and Peel, Ont.**

But shop practice is no bugaboo to the designer in concrete, and the form of truss which is the most economical is also the one which is the most natural and the most beautiful. The massive and gracefully arched compression chords are, perhaps, the most notable features of the few concrete truss bridges which have as yet been built.

The seven-panelled parabolic bowstring truss, illustrated above, was built on the Middle Road, between the counties of York and Peel, and officially opened to traffic this month. An examination of it will show that the maximum stress in the lower chord is the same for all its members, consequently the same number of steel rods are used from one end of the chord to the other—a great advantage in construction.

The vertical members of the web system are tension members, and the diagonals are of the nature of counter-braces, carrying no stress for live load covering the entire floor or from the dead load, and acting alternately in compression and in tension for a moving load.

The compression chord, 22 in. by 24 in. at the middle segment, is only slightly reinforced with twelve rods, ¾-in. round, and bonded with smaller rods spaced 6 in. apart, except at the panel points, where somewhat elaborate detailing is resorted to in order to make the bond perfectly secure between the hangers and the chord. The maximum compressive stress for this chord is 430 pounds per square inch for the concrete and 6,450 pounds for the steel, or about 500 pounds per square inch for concrete and steel acting together.

The maximum tension in the lower chord is 16,000 pounds for the steel, the concrete not being considered to act in tension.

In order not to cause internal stress in the concrete by some of the rods not being straight at the time the concrete is poured, and in order that hair cracks should not develop under 16,000 pounds tension in the steel the rods were given considerable tension before the concrete was poured by an ingenious device of the contractor.

The bridge was designed for a load of ten tons on two axles, two-thirds on the rear axle, and a distributed load of 100 pounds per square foot. A very liberal impact allowance was adopted of one-half the live load.

Extraordinary care was taken to avoid poor bonding of successive days' work. For this purpose cracked ice was laid in bags upon the last concrete placed at night, and this was found to be perfectly plastic the next morning, as if it had just been poured. This method of keeping concrete from setting by placing ice upon it, and thus securing a perfect bond between concrete placed on successive days, was the invention of Mr. O. L. Hicks, the contractor for this bridge. It is here mentioned by his permission for the benefit of any who may wish to use it.

The length of the bridge is 80 ft. in the clear; roadway, 16 ft. wide; height above water, 14 ft. at one end, 18 ft. at the other, making a grade of 5 per cent. It contains upwards of thirteen tons of steel, and weighs nearly 200 tons. Provision was made for expansion at one end by brass plates sliding between steel plates. It was tested at the official opening with a concentrated

* By Frank Barber, of Barber & Young, bridge and structural engineers, Toronto, Ont.

load of ten tons moving across the bridge, and by a herd of seventy cattle, all that could crowd upon the bridge, weighing probably thirty-five tons. The vibration under these loads was very slight.

The reinforcing consisted of plain, round rods except for the floors, which were reinforced with No. 10 standard expanded metal as manufactured by the Expanded Metal and Fireproofing Co., Toronto.

The mixture used was one of cement to three of aggregate, consisting of sand and crushed stone, so proportioned as to leave a minimum of voids. The bridge was concreted in one week by making special efforts, and the forms and floor were kept wet for another week. The concrete matured without showing any checks or hair cracks. Two inches was chiselled off the caps of the newel posts after the concrete had set as they were thought to be too large, and the mortar was found to be as hard as the stone which was embedded in it, for the stones would crack through quite as readily as the mortar. Owing to a misunderstanding these caps were left rough, but the writer regards this as a mistake. They should have been dressed smooth to harmonize with the rest of the bridge. Whatever may be the life of lean concrete mixtures, which are often used in massive work, the engineers believe that concrete proportioned in the above-mentioned way will endure indefinitely and grow harder and stronger with age.

**The Middle Road Truss Bridge, showing Forms in Position.**

In designing this truss the engineers believed that the joints required the most attention. It is easy to proportion all the members of a concrete truss so that perfect confidence may be placed in it if only the joints may be relied upon. The engineers tried to detail the bridge so that any member would fail in the body rather than at a joint. A description of these details is not here attempted, as it would, perhaps, be too technical to be of much interest to the general reader.

Compared with the ordinary (unhinged) concrete arch, the concrete truss has advantages and disadvantages. In the arch the horizontal thrust is resisted by the abutments, which are more or less perfectly restrained from spreading by the natural beds of the abutments—clay, rock, or whatever it may be. In the concrete truss the horizontal thrust of the arched compression chord is resisted by the steel rods in the lower chord. The advantage of this for the truss is that the toes of the arched chord are perfectly tied together at all times, and the upper and lower chords expand and contract together with temperature changes, provision for which is made by sliding bearing-plates at one end of the truss. Again, the tendency of the arched chord to deform for different positions of a concentrated load is resisted by the web members of the truss so that the line of resultant pressure in the compression chord does not move from the centre of its section. For this reason the chord segments act as posts, and are proportioned by their area.

In the arch, on the other hand, the abutments often spread somewhat, causing cracks in the spandrel walls. Again, temperature stresses and moving loads cause deformation of the arch-ring, which causes the line of pressures to vary in position. Even in a well-designed arch, where the resultant pressure never leaves the "middle third" of the section, the unit pressure at certain sections of the ring will be zero at the intrados and double the average at the extrados for certain temperatures and loadings, which state will be reversed for other conditions. Thus the section of the arch-ring must be proportioned by its moments of inertia, and will be greater than if the arch could be braced against deformation like a truss. We believe that bracing, where it is possible, is better and more economical than increasing the section.

To recapitulate, the arch has the great advantage, that no lower chord is necessary, or, to put it another way, the natural earth forms the lower chord; but the abutments are often not rigidly held from spreading, temperature stresses are considerable, and deformation must be resisted by making the arch-ring very heavy. In the case of the truss, an expensive lower chord must be supplied, but the toes of the arched chord are more rigidly held together by it than is often the case in arches, there are no temperature stresses, and the tendency to deformation is perfectly resisted by a web system, and a minimum amount of material results.

The Commissioners of York and Peel, for whom the bridge was built, were without exception delighted with the structure. When tenders were opened the bid for the concrete truss was found to be the second lowest, four tenders for a steel bridge being higher and one lower. Warden George Henry, of York, well supported by Warden Jackson, of Peel, spoke strongly in favor of the concrete bridge as being the most suitable bridge, and the cheapest in the end. Concrete was felt to be especially suitable for a bridge on a grade. Here teams cannot be prevented from trotting over it. The resulting vibration is likely to loosen joints and crystallize the steel, but is almost non-existent in concrete.

The reason that a truss was adopted at the Middle Road rather than an arch was that the truss bridge utilized the old stone abutments and an arch design could not.

Considère, the eminent French engineer, was the originator of the concrete truss, and he has built several of them in Europe. The approaches to the Sparkman Street Bridge at Nashville, Tenn., are also of this form. The bridge here described is the first concrete truss to be built in Canada.

The Commissioners for whom the bridge was built are Warden Henry and Commissioners Annis and Harris, of York, and Warden Jackson and Commissioner Kennedy, of Peel. The contractor was Mr. O. L. Hicks, of Humber Bay.

The bridge was designed and erected under the supervision of Barber & Young, bridge and structural engineers, of Toronto.

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### COST OF REPAIRS TO STEAM SHOVELS.

Repairs to steam shovels at Empire shops during the fiscal year 1909 cost only seven-eighths of a cent per cubic yard of material excavated, according to The Canal Record. The total cost of these repairs was $197,612.42, and the material excavated amounted to 22,583,099 cubic yards. The shop cost does not include the cost of repairs made in the field or that of repairs made to steam shovel parts taken to the shops while the shovel is kept in service by substituting other parts. These repairs are known as field repairs and are made in the field shops and on the work, often while the shovel is waiting for cars.

A statement of the cost of steam shovel repairs in the three construction divisions from January, 1908, to June, 1909, inclusive, a period of 18 months, follows:—

| | Divisions. | | | |
|---|---|---|---|---|
| Item. | Central. | Atlantic. | Pacific. | Total. |
| Cubic yards . | 27,752,750 | 4,148,997 | 1,980,069 | 33,881,816 |
| Field cost .. | $596,059.02 | $51,786.74 | $19,917.58 | $667,763.34 |
| Shop cost .. | $283,746.76 | $51,782.61 | $22,246.75 | $357,776.12 |
| Cost per cubic yd.: | Cents. | Cents. | Cents. | Cents. |
| Division ..... | 2.14 | 1.25 | 1.01 | 1.97 |
| Shop ..... | 1.02 | 1.25 | 1.12 | 1.06 |
| Total ..... | 3.16 | 2.50 | 2.13 | 3.03 |

The shovels in the Central Division are subjected to harder and more constant usage than those of the other two divisions. Of the 101 steam shovels in the Canal and Panama Railroad service 61 are in the service of the Central Division, most of them in Culebra Cut.

### COST OF SPREADING BROKEN STONE.

The stone was hand-broken and in piles along the roadway, Yonge Street, York County, Ontario. The average haul from the pile to their place in the macadam road was 600 feet. The force employed at the work was:—

| | |
|---|---|
| 1 man spreading 10 hours at 20 cents per hour.... | $ 2.00 |
| 5 men filling, 50 hours at 20 cents per hour ..... | 10.00 |
| 2 cart boys, 20 hours at 10 cents per hour ..... | 2.00 |
| 2 carts with horses, 20 hours at 15 cents per hour. | 3.00 |
| Total cost, 10 hour day ..... | $17.00 |

Work done:—

| | | |
|---|---|---|
| October 11th, spread ..... | 3.5 | toise* |
| October 12th, spread ..... | 4.0 | toise |
| October 13th, spread ..... | 4.75 | toise |
| Total spread ..... | 12.25 | toise |

12.25 toise, or 98 cubic yards cost to spread, $51.00;
or $4.16 per toise;
or 52⅛ cents per cubic yard.

*Toise is 12′ x 6′ x 3′, or 216 cubic feet.

### COST OF EXPERIMENT IN OILING STREETS.

During the past summer the city of Ottawa, Ont., applied oil **once** to about one and a quarter miles of roadway. The cost was as follows:—

| | |
|---|---|
| Oil f.o.b., Ottawa ..... | $236.93 |
| Demurrage on car ..... | 4.00 |
| Labor putting on ..... | 30.00 |
| Preparing special taps, valves, etc. ..... | 28.55 |
| Expert fees ..... | 25.00 |
| Total ..... | $324.48 |

Or almost $260 per mile.

This is much higher than it would be for regular work, but it is of value as to the cost of experimenting with oil for dustlaying.

Advocates of oiled roads place the cost at from $75 to $90 per mile.

### COST OF REPAIRS TO ROLLING STOCK.

On the Intercolonial Railway the cost of repairs to rolling stock was during 1907-8-9 as follows:—

| | | | | |
|---|---|---|---|---|
| Passenger cars, | 1907-8 | per car mile | 0.0194 | cents. |
| " " | 1908-9 | " " " | 0.0172 | " |
| Freight car .... | 1907-8 | " " " | 0.0073 | " |
| " " .... | 1908-9 | " " " | 0.0078 | " |
| Locomotives .. | 1907-8 | " " " | 0.0794 | " |
| " .. | 1908-9 | " " " | 0.0828 | " |

### ESTIMATING COST OF STEEL BRIDGES.

In October, 1909, the city of Toronto, Ont., called for tenders for steel superstructure for the Wilton Avenue bridge. It was estimated that the bridge would require about one million pounds of steel. As a fair estimating price for such work the following table may be of some interest:—

| | Steel Superstructure. | Estimated | Price |
|---|---|---|---|
| Tender. | Bulk Sum. | Weight—lbs. | Per lb. |
| No. 1 ..... | $51,725.00 | 1,066,500 | 4.85c. |
| " 2 ..... | 45,645.00 | 1,037,708 | 4.41c. |
| " 3 ..... | 45,622.07 | 990,080 | 4.61c. |
| " 4 ..... | 64,872.67 | 1,079,218 | 6.01c. |
| " 5 ..... | 48,200.00 | 1,000,000 | 4.82c. |
| " 6 ..... | 35,800.00 | 875,644 | 4.09c. |
| " 7 ..... | 54,500.00 | 1,080,000 | 5.05c. |
| " 8 ..... | 56,000.00 | 1,120,000 | 5.00c. |
| Average price of eight tenders ..... | | | 4.85c. |

It will be noticed the average price **including** the engineer's tender (No. 8) is 0.15 cents below the engineer's estimate, and **excluding** that tender the average price would be 4.83 cents or 0.74 cents per pound above the price of the successful tenderer.

Tenders No. 2, 3 and 4 were those of firms in Great Britain.

## THE COST OF POWER.*

Relative costs per kilowatt-hour for different kinds of power plants having a maximum load of over 30,000 K.W. Distribution of maintenance and operation.

| | | Reciprocating Steam Plant. | Steam Turbine Plant. | Reciprocating Engines and Low-Pressure Steam Turbines. | Gas Engine Plant. | Gas Engines and Steam Turbines. | Hydraulic. |
|---|---|---|---|---|---|---|---|
| | **Maintenance.** | | | | | | |
| 1 | Engine room, mechanical .... | 2.59 | 0.51 | 1.55 | 5.18 | 2.84 | 0.51 |
| 2 | Boiler or producer room ..... | 4.65 | 4.33 | 3.55 | 1.16 | 1.97 | .... |
| 3 | Coal and ash-handling apparatus | 0.58 | 0.54 | 0.44 | 0.29 | 0.29 | .... |
| 4 | Electrical apparatus ..... | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| | **Operation.** | | | | | | |
| 5 | Coal ..... | 61.70 | 55.53 | 52.44 | 26.52 | 25.97 | .... |
| 6 | Water ..... | 7.20 | 0.65 | 0.61 | 3.60 | 2.16 | .... |
| 7 | Engine room, labor ..... | 0.75 | 1.36 | 4.06 | 6.76 | 4.06 | 1.36 |
| 8 | Boiler or producer room labor.. | 7.20 | 6.74 | 5.50 | 1.81 | 3.05 | .... |
| 9 | Coal and ash-handling labor... | 2.28 | 2.13 | 1.75 | 1.14 | 1.14 | .... |
| 10 | Ash removal ..... | 1.07 | 0.95 | 0.81 | 0.54 | 0.54 | .... |
| 11 | Electrical labor ..... | 2.54 | 2.54 | 2.54 | 2.54 | 2.54 | 2.54 |
| 12 | Engine room lubrication ..... | 1.78 | 0.35 | 1.02 | 1.80 | 1.07 | 0.20 |
| 13 | Engine room waste, etc. ..... | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.20 |
| 14 | Boiler room lubrication ..... | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | .... |
| | Relative operating cost per cent... | 100.00 | 77.23 | 75.87 | 52.94 | 47.23 | 5.94 |
| | Relative investment per cent..... | 100.00 | 75.00 | 80.00 | 110.00 | 96.20 | 100.00 |
| | Probable average cost per kilowatt. | 125.00 | 93.75 | 100.00 | 137.50 | 120.00 | 125.00 |
| | Probable fixed charges per cent.. | 11 | 11 | 11 | 12 | 11.5 | 11 |

For steam turbine plants larger than 60,000 kw., the cost per kilowatt may be reduced to $75.

## COST OF HEATING A ONE ROOMED BUILDING.

The following figures represent the cost of heating a public school in Ontario. The inside measurements of the building are 31 feet long, 23 feet wide, and 14 feet high. There are two entrances protected by the porches which also have doors. The windows have a total of 108 square feet of glass. The room was heated by a furnace in the basement, and having compared the cost of heating several buildings of this class, find these figures represent the average very well.

**1904.**

| | | |
|---|---|---|
| 6.5 tons coal ..... | $46.13 | |
| 2 cords wood ..... | 15.00 | |
| | | $61.13 |

**1905.**

| | | |
|---|---|---|
| 7 tons coal ..... | $52.18 | |
| ¼ cord wood ..... | 2.50 | |
| | | $54.68 |

**1906.**

| | | |
|---|---|---|
| 9.5 tons coal ..... | $73.76 | |
| 1¼ cords wood ..... | 5.93 | |
| | | $79.69 |

**1907.**

| | | |
|---|---|---|
| 5 tons coal ..... | $36.50 | |
| 1 cord wood ..... | 5.00 | |
| | | $41.50 |

**1908.**

| | | |
|---|---|---|
| 10 tons coal ..... | $70.00 | |
| Wood ..... | 1.40 | |
| | | $71.40 |
| Total for 5 years ..... | | $308.40 |
| Average cost per year ..... | | 61.68 |

Or to heat 10,000 cubic feet per year cost $61.68, or about 62 cents per 100 cubic feet per year.

*From a paper by H. G. Scott, before the American Institute of Electrical Engineers.

## SOCIETY NOTES.

### CANADIAN SOCIETY OF CIVIL ENGINEERS.

As a result of the ballot canvassed on November 13th the following have been elected to the various classes of membership in the society:—

**Member.**

T. Aird Murray, Toronto.

**Associate Members.**

C. C. Chataway, Winnipeg; F. G. Goodspeed, St. John, N.B.; J. B. Strauss, Chicago, Ill.; W. G. Webster, Dunnville, Ont.; G. C. Williams, Walkerville, Ont.

**Transferred from Associate Member to Member.**

G. G. Grundy, Fraserville, P.Q.; Louis A. Herdt, Montreal; G. A. Janin, superintendent of waterworks, Montreal; W. P. Wilgar, Nepigon, Ont.; F. A. Wilkin, Winnipeg.

**Transferred from Student to Associate Member**

W. H. Blanchet, Peterborough, Ont.; W. J. Blair, New Liskeard, Ont.; W. G. Brown, La Tuque, P.Q.; E. V. Collier, Ottawa; A. P. Deroche, Ottawa; J. M. Donaldson, Croydon, Eng.; G. R. Ewart, jr., Makawell, Hawaiian Islands; G. H. Ferguson, Toronto; J. B. Harvey, Montreal; L. L. Hurtubise, Ste. Claire, Que.; W. L. Malcolm, Kingston, Ont.; A. W. McMaster, Toronto; A. G. Tapley, Pointe du Chene, N.B.

* * * *

**Central Railway and Engineering Club.**

At the meeting of the Central Railway and Engineering Club of Canada, held at the Prince George Hotel, Toronto, on Tuesday evening, November 16th, Mr. George H. Henderson of the Schofield-Holden Company, read an interesting paper on "The Gas Engine, Its Origin and Commercial Use." President C. A. Jeffers presided.

* * * *

**Ottawa Branch, Canadian Society of Civil Engineers.**

The first annual meeting of the Ottawa Branch of the Canadian Society of Civil Engineers was held in the Russell House on October 6th last. The election of officers for the year 1909-10 resulted as follows: Chairman, W. J. Stewart; Managing Committee, Arthur Bruce, A. A. Dion, A. T. Phillip, R. Donaldson, Naulon Cauchon; Secretary, S. J. Chapleau, Resident Engineer's office, Department of Public Works.

An expression of thanks by Mr. George A. Mountain, President of the Can. Soc. C.E., was made on behalf of the branch to the retiring chairman, Mr. Charles Coutlee, and the other officers of the initial management committee. Beyond this only routine business was transacted.

A reading and writing room for the branch is being prepared at No. 177 Sparks Street and will be ready for occupancy early in December.

There are about 107 members of all grades of the society resident within the Ottawa district.

(Continued on page 575.)

## PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

In the two preceding problems the determination of the stress in the various members of the cantilever truss (Fig. 67) was arrived at by graphical means, although a little trigonometry was occasionally made use of. It is possible, however, to arrive at these quantities analytically as indicated in the following discussion. In order to simplify matters, the reader is advised to draw the Statical Diagrams (Figs. 68, 70, 72, 75, and 77) on a loose sheet of paper so that they may be readily referred to.

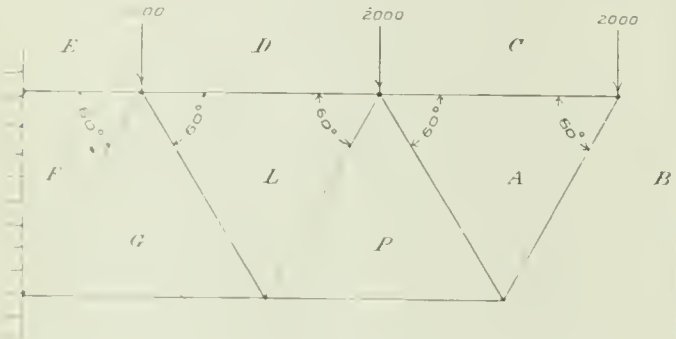



Fig. 67.

The following facts must be kept in mind throughout the problem:—

The **magnitude** of the X of any force = (magnitude of force) × (cosine of angle of inclination of force to the horizontal).

The **magnitude** of the Y of any force = (magnitude of force) × (sine of angle of inclination of force to the horizontal).

Also, if a set of forces be in equilibrium, $\Sigma X = 0$, and $\Sigma Y = 0$.

**Analytical Determination of the Stress in the Members of the Cantilever (Fig. 67).**

Consider the forces acting at the point BCA as shown in the Statical Diagram (Fig. 68). These forces are in equilibrium. Therefore, $\Sigma X = 0$; $\Sigma Y = 0$.

$\Sigma Y = Y_{BC} + Y_{CA} + Y_{AB} = 0$ ..... (1.)

Now, since CA and AB are unknown forces, the $Y_{CA}$ and $Y_{AB}$ will be assumed positive.

$Y_{BC} = -BC \sin 90° = -BC = -2{,}000.$

$Y_{CA} = CA \sin 0° = 0.$

$$Y_{AB} = AB \sin 60° = AB. \frac{\sqrt{3}}{2} \quad \text{..... (2.)}$$

Substituting these values in equation (1.).

$$\Sigma Y = -2{,}000 + 0 + AB. \frac{\sqrt{3}}{2} = 0.$$

$$AB = 2{,}000. \frac{2}{\sqrt{3}} = \frac{4{,}000}{\sqrt{3}}$$

If, now, this true value of AB, which is a positive quantity, be substituted for AB in equation (2.), it is seen that the assumed positive sign of the Y of AB remains unchanged. The assumed sign of the Y of AB is, therefore, correct; i.e., the Y of AB is positive.

If $Y_{AB}$ is positive, i.e., acts upward, AB is found to be a force acting against the pin. The member AB is, therefore, in compression $\frac{4{,}000}{\sqrt{3}}$ pounds.

For the same point:—

$\Sigma X = X_{BC} + X_{CA} + X_{AB} = 0$ ..... (3.)

$X_{BC} = BC \cos 90° = 0.$

$X_{CA} = CA \cos 0° = CA.$ $X_{CA}$ assumed positive since CA is unknown..... (4.)

$$X_{AB} = AB \cos 60° = AB. \tfrac{1}{2}. = \frac{4{,}000}{\sqrt{3}}. \frac{1}{2} = \frac{2{,}000}{\sqrt{3}}$$

Substituting these values in (3.).

$$\Sigma X = 0 + CA + \frac{2{,}000}{\sqrt{3}} = 0.$$

$$CA = -\frac{2{,}000}{\sqrt{3}}.$$

Substituting this true value of CA (a negative quantity) into equation (4.), the $X_{CA}$ is seen to be negative. If $X_{CA}$ is negative, CA must be a tensile force (acts away from the pin). From this, then, the member CA is seen to be in tension $2{,}000/\sqrt{3}$ pounds.

The forces acting at the point BAP, as shown in the Statical Diagram (Fig. 70), are in equilibrium.

$$\Sigma Y = Y_{BA} + Y_{AP} + Y_{PB} = 0.$$

$$-BA \sin 60° + AP \sin 60° + PB \sin 0° = 0.$$

$$-\frac{4{,}000}{\sqrt{3}}. \frac{\sqrt{3}}{2} + AP \frac{\sqrt{3}}{2} + 0 = 0.$$

$$AP = \frac{4{,}000}{\sqrt{3}}.$$

From the positive sign of this result the $Y_{AP}$ is seen to be positive; i.e., the force AP acts away from the pin. The member AP is, therefore, in tension $\frac{4{,}000}{\sqrt{3}}$ pounds.

For the same point:—

$$\Sigma X = X_{BA} + X_{AP} + X_{PB} = 0.$$

$$-BA \cos 60° - PB \cos 60° + PB \cos 0° = 0.$$

$$-\frac{4{,}000}{\sqrt{3}}. \frac{1}{2} - \frac{4{,}000}{\sqrt{3}}. \frac{1}{2} + PB = 0.$$

$$PB = \frac{4{,}000}{\sqrt{3}}.$$

The positive sign of the result shows that the $X_{PB}$ is positive. PB must, therefore, act against the pin, placing the member PB in compression $\frac{4{,}000}{\sqrt{3}}$ pounds.

The forces acting at the point PACDL are in equilibrium, and act as represented in the Statical Diagram (Fig. 72).

$$\Sigma Y = Y_{PA} + Y_{AC} + Y_{CD} + Y_{DL} + Y_{LP} = 0.$$
$$-PA \sin 60^\circ + AC \sin 0^\circ - CD \sin 90^\circ + DL \sin 0^\circ + LP \sin 60^\circ = 0.$$
$$-\frac{4{,}000}{\sqrt{3}} \cdot \frac{\sqrt{3}}{2} + 0 - 2{,}000 + 0 + LP \cdot \frac{\sqrt{3}}{2} = 0.$$
$$LP = \frac{8{,}000}{\sqrt{3}}.$$

The positive sign of the result shows that the $Y_{LP}$ is positive; i.e., acts upward. In accordance with this, LP must act against the pin, placing the member LP in compression $8{,}000/\sqrt{3}$ pounds.

For the same point:—

$$\Sigma X = X_{PA} + X_{AC} + X_{CD} + X_{DL} + X_{LP} = 0.$$
$$PA \cos 60^\circ + AC \cos 0^\circ + CD \cos 90^\circ + DL \cos 0^\circ + LP \cos 60^\circ = 0.$$
$$\frac{4{,}000}{\sqrt{3}} \cdot \frac{1}{2} + \frac{2{,}000}{\sqrt{3}} + 0 + DL + \frac{8{,}000}{\sqrt{3}} \cdot \frac{1}{2} = 0.$$
$$DL = -\frac{8{,}000}{\sqrt{3}}.$$

The negative sign of the result shows that the $X_{DL}$ (since the X equation is being used) is negative. DL is, therefore, a tensile force (acts away from the pin); i.e., the member DL is in tension $\frac{8{,}000}{\sqrt{3}}$ pounds.

The reader is advised to try and determine the stresses in the remaining members before referring to the solution as herein given.

(These solutions will be given next week.)

## SOME OBSERVATIONS ON THE STABILITY OF DAMS.

By J. F. Jackson, M.W.S.E.*

In view of the rapidly growing interest in the subject of water power development and reservoir storage of water for various purposes, it has seemed to the writer opportune to present for discussion some more or less unorthodox observations on the manner of calculating and constructing the various generally accepted types of dams.

In the old-fashioned timber dams, hundreds of which have been built for logging and power purposes, on all sorts of foundations, it was customary to give the water-tight surface of dams a slope upstream, generally two or more horizontal to one vertical, making a cross section something like Fig. 1 in the case of an overfall dam. In case the height was considerable, the apron would be divided into two or more steps, to break the fall of the water.

For the purpose of a coffer-dam of moderate height on solid rock or impervious bottom, the same general idea is satisfactory, as shown in Fig. 2.

In this diagram the planking is shown laid at slope of one to two. Note the position and direction of the resultant of water pressure. Little theoretical study, as far as the writer knows, has been given to these forms of dams.

It is obvious in each of the above cases that the weight of the water and the back filling have been a large or the entire factor in the stability of the dam, both against sliding and overturning. "Castor Fiber," who belongs to the oldest race of dam builders, has always utilized the weight of water for stability, and some of his achievements have been truly remarkable. The lower part of his dams are always open for drainage. The writer contends that his work is more scientific than that of some of our modern builders, as will be demonstrated later.

Now when it comes to the construction of masonry dams, the first ones were probably built entirely by guess, but some of them stood up. A precedent having been established, in course of time, mathematicians came along and found that

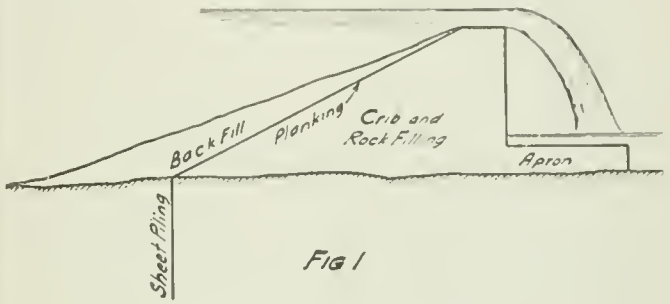



FIG 1

Cross Section of Timber Dam.

masonry structures having a factor of safety of two against overturning and of one against sliding on their bases were actually standing up. Therefore a coefficient of friction of 0.6 or 0.7 was assumed, and a sufficient weight of masonry provided to resist the horizontal hydrostatic pressure of the reservoir. Hence we have the standard triangular or trapezoidal section as shown in Fig. 3, in which the resultant pressure of water and masonry usually falls just inside or at the middle third of the base, so that pressure begins practically at zero at the inner heel and increases to a maximum at the outer toe, as illustrated above, provided the structure acts as a unit. The pressure of water and weight of masonry are such that the coefficient of friction is barely sufficient to resist sliding. In fact, if it were not for the dove-tailing into rock at the base of the dam and into the walls of the gorge between which the dams are built, there would be many more failures by sliding than there have been. However, so far as

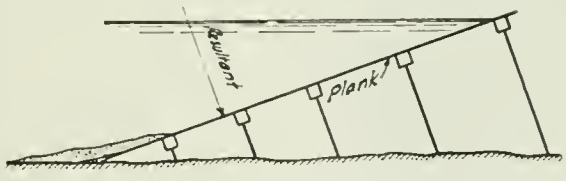



FIG 2

Cross Section of Coffer-Dam for Shallow Water.

mathematics are concerned, we have the astounding fact that in masonry structures of immense importance, and in perhaps no other cases, engineers are content to follow in the rut and build with a factor of safety of one! So much for precedent. Further than this, as soon as you assume hydrostatic uplift, or that water enters under the edge "A" of your dam, your precious friction coefficient is partially destroyed, and the dam fails. It is only fair to say that most engineers now make some attempt to drain toward the downstream toe of the dam. (See Transactions of Am. Soc. C.E. Vol. 34. Notes on High Masonry Dams by John D. Van Buren, for argument in favor of a section of masonry dam taking into account hydrostatic uplift. Of course, the form of masonry dam is somewhat circumscribed by the fact that no tension

*Read before the Western Society of Engineers, June, 1909.

is assumed on the upstream face, but the writer nevertheless believes it quite possible to develop a form of masonry dam in which the weight of water and possible back fill is utilized to add stability, and may propose something of that sort in the future. He surely believes that the ordinarily accepted coefficient of friction as indicated above and the factor of safety of two against overturning, should not be accepted as sufficient.

In earth dams, the writer believes, of course, that the section should be something like that shown in Fig. 4.

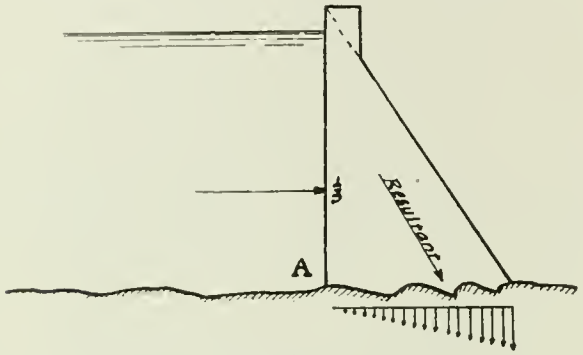



Fig 3

**Typical Cross Section of Masonry Dam.**

The same idea applies to an earth dam, a rock fill dam or like structure with a cut-off planking, reinforced concrete, steel plate, or common puddle. In every case water-tightness should, if possible, be secured as near the water itself as possible, and the vertical components of the hydrostatic pressure should be equal to or exceed the horizontal ones. Western engineers have already followed this idea to some extent in earth and in rock fill dams with planking.

Designers of concrete dams have usually followed the standard masonry profile or something near it. It is human nature, in engineering matters as in other affairs, to follow and develop an established idea, sound or unsound, to its utmost limits, while a new one or a very old and forgotten one, must make its way slowly.

Happily, Bainbridge with his steel dam, and Ambursen with his concrete dam, and the idea of the reinforced concrete

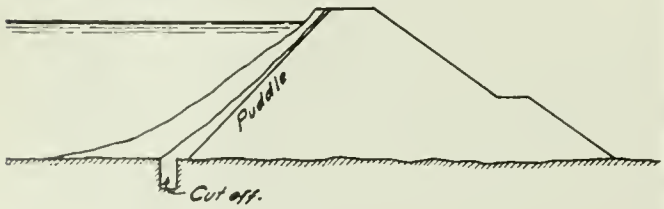



Fig. 4.

**Typical Cross Section of Earth Dam.**

retaining wall came along, so that it is now in order to consider a dam having a water-tight face capable of taking tension. Bainbridge's dam consists of a series of inclined bents covered on the upstream side with water-tight concave plates. (See Journal W. S. E. Vol. X, p. 615.) In this dam, water pressure is of course taken normal to the water-tight face (Fig. 5). The column loads are taken directly to the rock bottom, and tension of face plates is taken up by anchor rods, as indicated. If not founded on rock, the design must be altered radically, as indicated further on.

Although the Ambursen dam (Fig. 6) utilizes the weight of water to some extent, in my opinion it does not, as ordinarily constructed, provide much greater stability against sliding than the standard profile, though it does thoroughly provide against hydrostatic uplift by the open construction of its base. The main idea of Ambursen's patent was apparently to so construct the water face of his dam with reference to the cross walls that the direction of water pressure at any point should fall within the base.

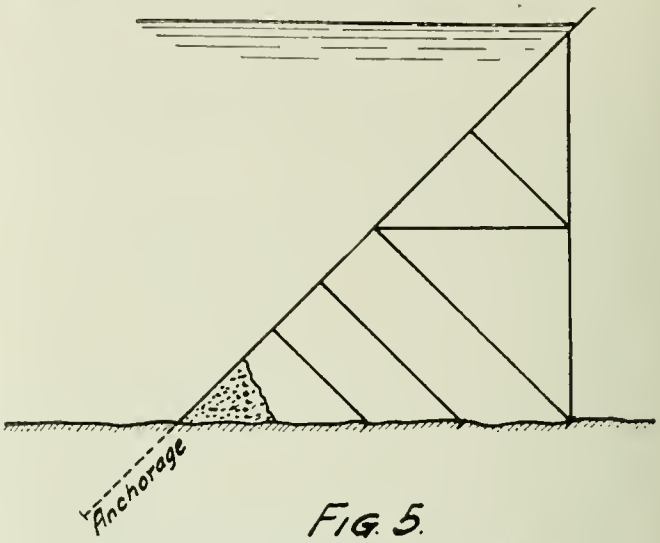



Fig. 5.

**Cross Section of Bainbridge Steel Dam.**

Of course, the calculation of stability of a steel dam on rock bottom, with given factors of safety, is very much simpler and more certain than even the design of a steel railroad bridge, and the writer believes that the time is coming when the merits of this construction will be much more appreciated by engineers than is the case at present.

In designing the cross section of a steel dam about 100 feet high, the writer accidentally hit on the idea of making

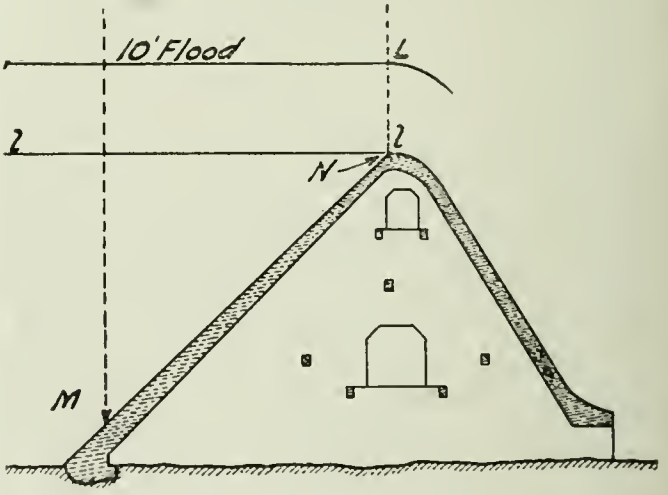



Fig. 6.

**Cross Section of Ambursen Dam.**

the part near the top, where hydrostatic pressures are light, nearly vertical, and sloping the part near the bottom, where hydrostatic pressures are heavy, until it was nearly horizontal. This resulted in a saving in construction cost, and a greatly increased factor of safety against sliding and overturning.

The idea illustrated in Figs. 7 and 8, where the plating on the lower section is supported directly in concrete, cheap masonry, or other filling, while the upper part is of steel con-

struction. The amount, position, and direction of resultant pressures depend on the exact shape of the water-tight surface. The vertical water pressure may be made 1.5, 2 or even 3 times the horizontal pressure, depending on the width of base and the resultant pressure of all, weight of water and structure, may be brought as near the centre as desired. In Fig. 7 is shown a dam of considerable height, and in Fig. 8 one of moderate height.

The limits of this idea are shown in Fig. 9. Suppose we have a dam built of a small bent plate: calling the height 24 in. the base 14 in., the horizontal water pressure would be 2,

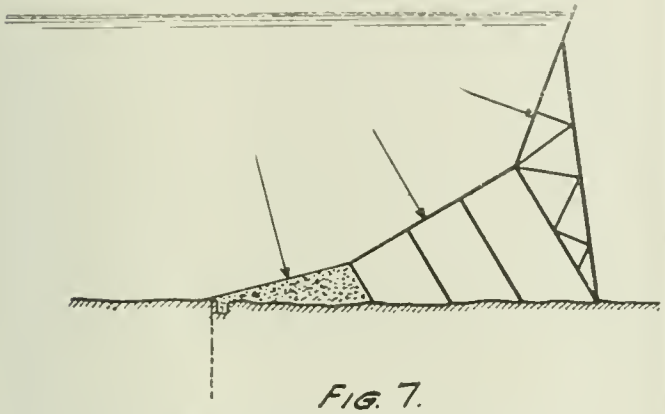


FIG. 7.

**Cross Section of Suggested Concrete and Steel Dam.**

applied at 8 in. from the base; the vertical pressure would be 2.33, applied at 7 in. from the bend. The resultant would be 3.1, applied practically at the bend. The structure would be just a little more than stable against overturning, and a friction coefficient of 0.86 would be sufficient to prevent its sliding.

In case the base were 24 in. and the height 24 in., as in Fig. 10, the horizontal water pressure would be 2 as before, and the vertical pressure would be 4, and the resultant 4.5, falling at a point one-third of the distance from the bend to

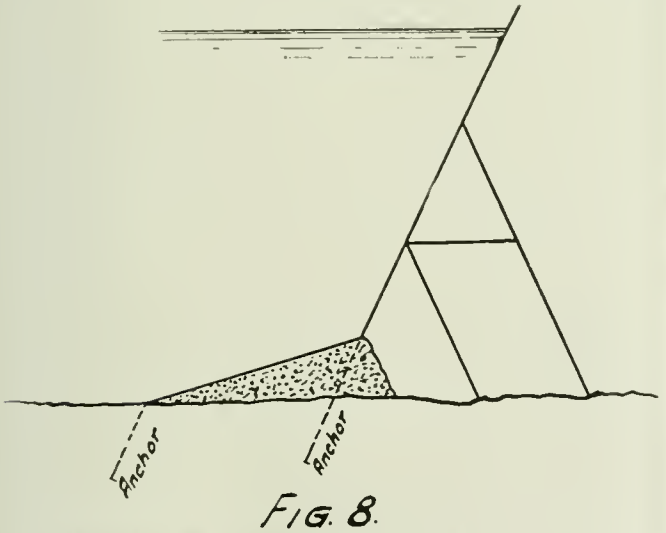



FIG. 8.

**Another Suggestion for Concrete and Steel Dam.**

the upstream edge of the horizontal plate. This resultant would stand two vertical to one horizontal, giving a coefficient of 0.50 to just prevent sliding. If you prevent leakage at "A" and your plate is stiff enough to prevent bending, you will have, due to water pressure alone, a small dam as safe against overturning and safer against sliding than the standard profile. It is evident, then, that in a dam having a base equal to its height, the sum of all horizontal pressures is exactly that due to the depth of the water, no matter what the shape of the water-tight surface, and it is possible to utilize the vertical pressures from a minimum of zero to a maximum of two times the sum of the horizontal forces, and to bring the resultant of both forces from a horizontal direction to an inclination of two vertical to one horizontal, as shown. Of course, in the practical structure of steel of the Bainbridge type or of concrete, wood, or other material, we would curve the tension face in some manner, and in making our calculation add the weight of the structure itself.

In Fig. 11 is shown the proposed section of a reinforced concrete dam having a concave water tight face. Please note the position and direction of the resultant of the water pres-

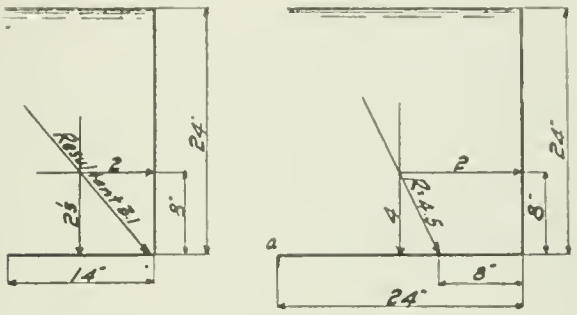
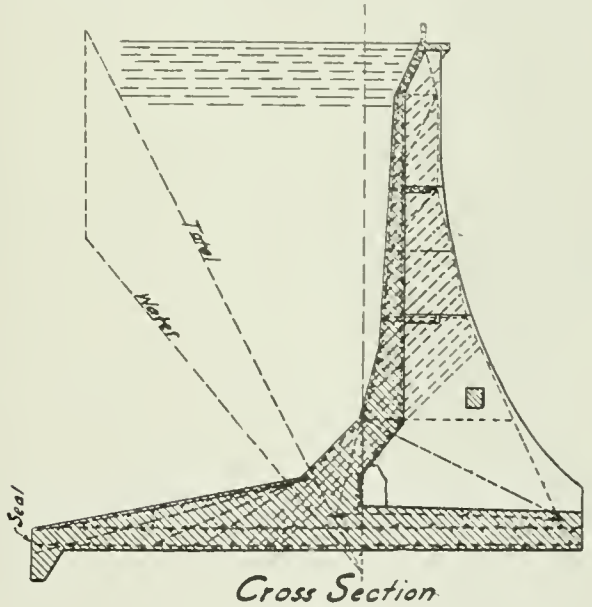



FIG. 9. FIG. 10.

**Cross Sections Showing by Bent Plates the Principle of Dam Suggested by Author.**

sure and also note that the total resultant falls about half way between the centre and the 1/3 point. It is designed to be a very heavy and substantial structure, but contains only about one-half the amount of concrete of that required in a dam of standard cross section.




Cross Section

FIG. 11.

**Proposed Typical Section of Reinforced Concrete Dam Suggested by the Author.**

In this particular case the water pressure resultant stands at an angle of five vertical to four horizontal, and the total resultant at eleven vertical to five horizontal, and the structure very evidently has some stability against both overturning and sliding. A spillway section employing this principle also works out very favorably in either steel or concrete.

The patent office has recently recognized this principle of using hydrostatic pressure on a concave face to add stability to dams, etc. So far as the writer knows, this is the first recorded recognition of the hydrostatic principle involved. He does know, however, of a mining engineer out West who once built a small concrete dam wrong side to, and with very good results.

The modern inside buttressed reinforced concrete retaining wall employs a similar idea, but the earth pressures are not hydrostatic. In the earthen dam with masonry core wall, the hydrostatic pressure against the core is of course greatly modified (but nobody knows how much) by the presence of the earth fill on the water side. Its design is eminently a matter of guess work.

In conclusion, my contention is that a factor of one against sliding is not enough, and that we should turn the hydrostatic force to our assistance, instead of working entirely against it. We must have weight to secure stability, and there is nothing for that purpose quite so cheap as the water itself which we are undertaking to confine.

If the above observations on dam stability of various new and old sections provoke spirited discussion of the ideas involved, the writer believes that a service will have been rendered the engineering profession.

## MUNICIPAL GAS PLANT EXPERIENCES.*

By C. E. Moore, C.E., Santa Clara, Cal.

The town of Santa Clara has one of the two municipal gas plants on the Pacific Coast, so far as known to the writer. There is nothing remarkable about this plant except the fact of its being owned and managed by the municipality. The writer has for several years been acting as consulting engineer for the town, and as such had charge of the construction of the water and electric plants which preceded the gas plant. When gas was taken up it naturally followed that the same arrangement was carried into that. Therefore it will be understood that the engineer as well as the town council had much of the gas business to learn, and that the writer of this does not assume to be an expert in gas matters. However, having been identified with the enterprise since its establishment, and continuing at present to be in touch with it, and since the plant occupies rather a unique position, it has seemed that a brief account of its career may be of interest.

The account will naturally fall somewhat into the lines of a discussion of municipal ownership, but this will not be with the object of establishing any extreme views, but rather with the idea of drawing such inferences as are possible from our experience. Regarding the broader question of general municipal ownership, the writer has come in contact with it in many other places and inevitably his views are somewhat colored by the sum total of all this experience, but the effort will be here to confine deductions as strictly as possible to those following from this case.

To make the situation clear, it will be necessary to first state in a brief way the cause which led up to this particular municipal ownership. Twelve years ago the town of Santa Clara took up the ownership of water supply. For this there were several powerful reasons, the chief one, perhaps, being the necessity for better fire protection. The plant was successful from the start.

There was also a desire for a more extended system of street lighting, and it seemed advisable to take that up in connection with the water plant. This plant was installed ten years ago. It also was satisfactory, and the people came to have considerable pride in the plants. Every town, like an individual, likes to have something to talk about, and the municipal plants came to be the thing to talk about in Santa Clara. The matter now passed beyond the case of necessity, and the later movements along this line have been largely the result of the impetus of the idea. Municipal ownership became a specialty. Commercial electric lighting was taken up by buying the property of the electric lighting company, remodeling and extending the system and combining it with the street lighting.

Current for this purpose was formerly generated by the town, but for several years past has been bought from the San Jose Light & Power Company, and it is supplied by the Standard long-distance transmission lines.

Gas has been supplied by the San Jose Gas Company (later the Light & Power Company), for many years, by a pipe line from their works. The condition of the town has been such that there had been little encouragement for the company to extend their lines. There had been no special effort to push the business, and the consumption was only 10,000 feet per day. However, with the coming of renewed life to the town there began to be felt a desire for more extended service. Chiefly the development of the gas plant may be considered as due to the idea which had taken root. There was no particular dissatisfaction with the company, and the movement was entirely devoid of enmity to it. Accordingly all the property of the company in the town was purchased at a valuation made by an expert agreed upon by both parties. The transaction was amicable and satisfactory throughout.

There has since been considerable consumption (chiefly for fuel purposes), and the output at present is 35,000 per day. The price of gas was at first fixed at $1.75 per thousand, that being the price charged by the gas company. Later for service in San Jose the company made the rate $1.50, but no reduction was then made by the town. Still later the company reduced the rate to $1.25, when the town followed with a reduction to $1.50. That is to say, the town has in the matter of rates made no reduction until virtually forced to do so by the company. Of course there is no direct competition between the two, but inasmuch as they serve adjoining territory, it is in practice difficult to maintain much higher rate in one than in the other. It will perhaps be apparent from the foregoing that an attempt has been made to manage the plant on business principles, and not to be carried away by any popular idea that something could be got for nothing.

About 10,000 feet of pipe was taken over from the company. Since that time there has been laid about 50,000 feet

It has been necessary to do the work largely with unskilled labor. At the beginning the work done in remodeling the distribution system was from necessity advertised. The contractor who took the work was not accustomed to laying the pipe. The blocks in many cases have very little fall, barely enough for surface drainage. Under these circumstances the writer put in force a system of laying to grades previously established by levels, and this system has been followed for extensions. This is done so simply, with so little trouble, and with such good results from entirely unskilled labor in grading the trench, that it would seem good policy for any company working in a flat country to follow the same system. In the old pipes, laid in the old way, with a spirit level, there have been frequent stops and stoppages. In the new mains there have not been any at all. The number of drips is by this system kept small, and these are located at convenitent points. It may be that some gas

* A paper before the California Gas Association.

companies use similar methods, but so far as I know they generally do not. The exact methods used had previously been developed on sewer work. Now as to the conclusions which may be drawn from our experience:

First, the plant and business needs continual and watchful care. In our case the care has been provided, and consequently the business has been successful. It has been very fortunate that there have been few changes of officials. The office of President of the Board, or Mayor, during all this time has not changed. The chairman of the water and light committee also is an old-timer, and has from the first been identified with the business. Questions of policy have been given careful consideration; just as careful as though it had been their own business. The result has been a good profit, but it is very easy to see how the balance might have been the other way. This is the chief danger that confronts any scheme of municipal ownership, namely, that men of ability may not be willing to give their attention to the town's business, or that the people will not have the good sense to keep that sort of men at the head of affairs.

Second, as to the ability to meet emergencies. We had an experience of this kind growing out of the partial wrecking of all plants by the earthquake. This rests upon the men and not upon the system. In our case we feel that we have no cause for regret, inasmuch as water was supplied in about 24 hours, and gas in three days. This goes back to the first question of management.

Third, the ability to provide extensions.

In this particular the municipality is decidely at a disadvantage. Whereas, a company can in this case borrow money to meet a large increase in the demands upon it, a municipality can not do this except a bond issue, which cannot be resorted to in all cases. Consequently it is necessary to look well ahead and provide far in advance for such extensions of magnitude as are likely to be necessary.

Fourth, as to the attitude of customers. In these matters we are dealing not only with gas but with human nature, and this is practically the same the world over. There is an occasional demand for lower rates, in the case of the town, as there would be with the company. There is the same distrust of meters. About half the consumers consider the collector and meter reader to be their natural enemy. The people's pride in the plant is chiefly in the abstract, and does not particularly affect their attitude toward bills, and service. And yet it is not quite fair to let the question go at that, for there is a certain amount of feeling of individual ownership, which probably makes the conduct of these matters a trifle smoother than in ordinary cases.

Fifth, general conclusions.

The conviction of the writer is that no municipality should be advised to undertake the management of plants for the sake of profit, solely, as an individual or company may do. There should in general be other and stronger reasons. In the case of water, there often are such reasons. As we leave water supply and look along the line of other utilities, we find that in general these causes have less force. This does not mean that gas should be supplied at cost. In the first place, in a developing community extensions and increased facilities in every way are certain to be needed. If gas is supplied at cost all this must be accomplished by taxation.

Secondly, the question of exact cost is a precarious one at best. It must include all unexpected and emergency expenses and can really only be determined after a long term of years.

The probability is that selling at a cost determined from ordinary expenses would finally result in the plant requiring support from other resources of the town.

## SOCIETY NOTES.

(Continued from page 569.)

**Toronto Branch, Canadian Society of Civil Engineers.**

At a meeting of the Toronto branch of the C.S.C.E., held in the Chemistry and Mining Building of the University of Toronto, on Monday evening, November 15th, Mr. Allen Hazen, consulting engineer, of New York, who was recently engaged by the City of Toronto to give expert advice in connection with the installation of a filtration plant, delivered an interesting lecure on "Water Filtration." The developments of the past eighty years were traced and illustrated by lantern slides. Views and diagrams relating to the water supply of different cities in Europe and the United States were also shown, the references to the plant at Albany, New York, the fundamental details of which are included in the scheme adopted by Toronto, being especially interesting. Of interest to many were the figures quoted to show the desirable effect the installation of meters has on the amount of water consumed.

Mr. J. G. G. Kerry, C.E., chairman of the Toronto branch of the society, presided at the meeting, and among others present were Dr. Sheard, City Engineer Rust, Dean Galbraith of the Faculty of Applied Science, Dr. Oldright, Mr. J. Fleming Goodchild and Dr. King, representing the Toronto Academy of Medicine.

## RAILWAY ORDERS.

(Continued from page 565).

tracks of the British Columbia Electric Railway Company near Front and Columbia Streets, Vancouver, B.C.

8576—October 27—Dismissing application of the city of Vancouver for an Order authorizing the opening of Clarke Drive across the tracks of the C.P.R. Company, that city.

8577—November 3—Granting leave to the Nipissing Power Company to erect, place, and maintain its transmission lines across the track of the G.T.R. Company at Nipissing Junction, in Township of Ferris, Ont.

8578—November 3—Granting leave to the G.T.P. Railway to carry freight traffic over its line of railway from Battle River to Edmonton, Alta.

8579—November 2—Authorizing the C.N.Q. Railway to take parts of Lot No. 213 in Parish of St. Charles Borromee, and parts of Lot No. 2 in town of Joliette, County Joliette, P.Q., for the purpose of securing the efficient operation of its railway.

8580—November 2—Dismissing application C.P.R. for Order extending provisions of Order No. 7813, dated July 3rd, 1909, authorizing the city of Toronto to construct bridge to carry the highway and tracks of the Toronto Street Railway Company over tracks of the C.P., G.T., and C.N.O. Railways, where such tracks cross Queen Street East in said city, so as to provide that when said bridge is completed it be closed for pedestrian and vehicular traffic.

8581—November 2—Dismissing application of city of Toronto, Ont., to construct high level bridge over Don Improvement and Canadian Pacific, Grand Trunk, and C.N.O. Railways at Queen Street, Toronto, Ont.

8582—November 9—Granting leave to the C.P.R. to load and unload on the Lord's Day to and from car ferries plying between Ashtabula, Ohio, and Port Burwell, Ont.

8583—November 5—Authorizing (temporarily) the tariff of tolls the Bell Telephone Co. shall charge, and form of agreement to be made between it and several rural telephone companies in the Province of Ontario.

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal President, George A. Mountain; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto. Meet last Thursday of the month.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coultee, Box 560, Ottawa; S. J. Chapleau, Box 203.

**MUNICIPAL ASSOCIATIONS.**

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES. — President, H. H. Gaetz, Red Deer, Alta.; secretary-treasurer, John T. Hall, Medicine Hat, Alta.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

## CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator Company, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE. — Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB. — President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, C. A. Jeffers; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY. — President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrell.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB. — President Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

## AMERICAN TECHNICAL SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS. — President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS. — President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

(Continued on page 50.)

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital In Thousands | Par Value | EARNINGS Week of Nov. 14 1909 | 1908 | STOCK QUOTATIONS TORONTO Price Nov. 5 '08 | Price Oct. 28 '09 | Price Nov. 4 '09 | Sales Week End'd Nov 4 | MONTREAL Price Nov. 5 08 | Price Oct. 28 09 | Price Nov. 4 '09 | Sale Week End'd Nov.4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $2,130,000 | 1,676,000 | | 184½ | 181 | 116 | 178½ | 178 | 184½ | 154 185 183 879 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 369 800 | 264,500 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 921,271 | 854,223 | ..... | *1st. pref. 108½, 3rd pref. 57½, ordinary 23½ | | | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 75,817 | 68,215 | ..... | ..... | ..... | ..... | 199½ | 199½ | 209 | 208½ 208 200 160 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,498 | 67,891 | ..... | 123½ | 123½ 122 | 325 | 100½ | 100 | 124½ | 123½ 123 122½ 628 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 169½ 168½ | 184½ | 184 183½ | 40 | | 169 | ... | 183 ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## T. & N. O. EARNINGS

The earnings of the Temiskaming & Northern Ontario Railway for the week ended November 7th, were:—1909, $33,458.81; 1908, $17,286.03; increase, $16,172.18.

* * * *

The earnings of the Guelph Junction Railway for the quarter, ending 30th September, 1909, amounted to $7,492.26, as against $0,706.88 for the same quarter of last year. This will make the total amount of receipts during the year $25,756.79, as against $22,378.10 received during the same period last year.

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston

## TORONTO AND YORK RADIAL.

President, William Mackenzie.
Manager, W. H. Moore.
Chief Engineer, W. B. Boyd.
Purchasing Agent, A. M. Grantham.

**Kind of Road:** Suburban.

**Length of Road:**

Double track, 0 miles.
Single track, 81 miles.
Total in single miles, 81.

**Character of Service:**

Car equipment, 56: type, G. E. Co. and Westinghouse.
Power of motors, 35 h.p. to 75 h.p.
Method of controlling, simple controllers and master controllers.
Method of braking, air and spindle.
Gauge of track, 4 ft. 8½ in., and 4 ft. 10⅞ inch: weight of rails, 56 and 60 lbs.

**Power:**

Direct current, D.C.
Alternating current, A.C.
Voltage of transmissions, 16,000.
Trolley voltage, 550.
Frequency of transmission for A.C., 60 cycles.
Number of phases, 3-phase.

## WINDSOR, ESSEX AND LAKE SHORE RAPID RAILWAY COMPANY.

President, W. C. Crawford, Tilbury, Ont.
Vice-President, John Piggott, Chatham.
Managing Director, W. T. Piggott, Kingsville, Ont
Chief Engineer, W. A. Chisholm, Kingsville.
Purchasing Agent, W. T. Piggott, Kingsville, Ont.
Superintendent, A. W. Westman, Kingsville, Ont.

**Kind of Road:** Interurban.

**Length of Road, in miles:**

Total in single miles, 37.28.

**Character of Service:**

Type, Westinghouse, No. 132, A.C.
Number of motors, 14.
Power of motors, 100 horse-power.
Method of controlling, potential hand control on passenger motor cars; multiple-unit potential control on locomotive.
Method of braking, S.M.E. air brake on passenger motor cars; standard automatic and straight-air combined on locomotive.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 60 and 80 lb. used. Switches, sidings, and stub ends use the 60 lb.

**Power:**

Two direct connected units, 500 K.W. each.
Direct current, none.
Voltage of transmission, 13,200 volts.
Trolley voltage, 6,600 volts.
Frequency of transmission for A.C., 25-cycle.
Number of phases, single.

## THE OTTAWA ELECTRIC RAILWAY COMPANY.

President, A. Ahearn.
Superintendent and Purchasing Agent, J. E. Hutcheson.
Secretary and Treasurer, James D. Fraser.

**Kind of Road:** Suburban and Street Railway.

**Length of Road, in miles:**

Total in single miles, 40.

**Character of Service:**

Car equipment, No. 160; type, open and closed.
Number of motors, 200; power of motors, 30, 40 and 50 horse-power.
Method of controlling, ordinary.
Method of braking, hand and Westinghouse air.
Gauge of track, 4.8½.
Weight of rails, 70 to 80, T

**Power:**

Direct current, 600 v.
Trolley voltage, 600 v.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Nova Scotia.**

HALIFAX.—Tenders will be received until December 6th, for 3,000 feet of 2½-inch rubber hose, to stand a pressure of 300 lbs. per square inch on delivery, and 200 lbs. in ordinary fire service. A 3-year guarantee is required. Bids submitted some time ago, for the same material, on another basis, were returned. Mr. F. W. W. Doane is city engineer.

**Quebec.**

ARTHABASKA.—The secretary-treasurer of the council of the County of Arthabaska will receive up to Thursday, December 9th, tenders for the construction of a steel bridge on the Becancour River, between the municipalities of St. Louis of Blandford and the township of Stanfold. Louis Lavergne, secretary-treasurer.

HULL.—Tenders will be received until Monday, 6th December, 1909, for pumping equipment. R. W. Farley, City Engineer. (Advertisement in the Canadian Engineer.)

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

QUEBEC.—Tenders will be received until Tuesday, the 30th November, for the building of the substructure of the Quebec Bridge. The general specification and form of tender will be ready about November 20th; but in the meantime contractors are invited to visit the office of the Quebec Bridge Board of Engineers, Canadian Express Building, Montreal, for the purpose of securing preliminary information to enable them to submit tenders for this work. L. K. Jones, secretary, Department of Railways, and Canals, Ottawa.

**Ontario.**

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

PETERBORO.—Tenders will be received until November 20th for heating, plumbing and wiring the public library. Mr. John E. Belcher, C.E., architect. Mr. S. R. Armstrong, city clerk.

TORONTO.—Tenders will be received until Wednesday, November 24th, for pole line supplies. Specifications may be seen at the Electrical Department. Jos. Oliver, (Mayor), Chairman, Board of Control. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until December 7th for annual supplies, including:—Cement, gravel, paving materials, lumber, pipe, bricks, etc. Further particulars are given in our advertising columns. Mr. Joseph Oliver, (Mayor), Chairman, Board of Control.

TORONTO.—Tenders will be received until Monday, November 22, for additions and alterations to the Toronto General Post Office. Plans may be seen at the office of Mr. Thomas Hastings, clerk of works, Customs Buildings, Toronto; N. Tessier, secretary, Department of Public Works, Ottawa. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders for electric wiring in the branch library on the north-west corner of Gerrard Street and Broadview Avenue will be received up to Thursday, November 25th. E. S. Caswell, Secretary-Treasurer, Toronto Public Library.

**Manitoba.**

HARTNEY.—Tenders will be received up to December 6th, at 5 p.m., for the construction of a pile bridge across the Souris river on section 25—5—25, near Lauder. Plans and specifications may be seen at my office in Hartney. T. B. Woodhull, secretary-treasurer, Municipality of Cameron.

ROSSER.—Tenders will be received up to Saturday, November 27th, for the sale of one 40 horse-power gasoline walking dredge. W. H. Beachell, secretary-treasurer.

WINNIPEG.—Tenders will be received for drainage, requiring approximately the removal of over 200,000 cubic yards of material, up to noon of Monday, the 22nd of November. Arthur Stewart, 323 Main Street.

**Alberta**

CALGARY.—Tenders will be invited by this municipality for six additional new steel cars of the pay-as-you-enter type. They are to be five feet longer than the cars now in use, and will be equipped with air brakes. Exclusive of the motors, it is expected that they will cost approximately $25,000, f.o.b. Calgary, for early spring delivery. Mr. J. T. Child is the city engineer.

## CONTRACTS AWARDED.

**New Brunswick.**

MONCTON.—Tenders for valves were received as follows: Sumner Company, $105.80; Peiler, McKenzie & Lodge, $131.75; Canadian Fairbanks Company, St. John, $129. The lowest was accepted. The J. E. Masters Coal Company was given a contract for 500 tons of Gowery coal at $2.75 f.o.b., Moncton.

**Quebec.**

MONTREAL.—The City of Montreal recently invited tenders for the construction of a five-foot circular sewer, with the necessary connections, on Sherboroke Street, from Victoria Street to Drummond Street, and received the following, that of Henault & Hefferman, $25,266 being accepted:—

| | |
|---|---|
| Henault & Hefferman | $25,266.00 |
| Gilbert & Toussaint | 28,988.25 |
| Canadian General Developing Company | 33,307.95 |
| L. Gignere & Company | 28,987.50 |
| M. Lapointe | 32,476.50 |
| M. Dineen | 25,474.50 |
| John Leahy & Company | 32,827.50 |
| Michael Maisan & Company | 36,769.50 |
| Decarie & Taillefer | 25,488.75 |

NOTRE DAME DE GRACE.—The contract for the new school was awarded to the Canadian Construction Company at $13,400 for one-half the job, or $20,400 for completed work. Other tenders were: Morrison $23,000; Whitaker $24,000.

**Ontario.**

BRACEBRIDGE.—Contracts for general work and the equipment of a new power plant were awarded a few days ago. The following tenders were received:

"A," General Division: For construction of general works of the hydro-electric development of Wilson's Falls, Muskoka River, consisting of dams, coffer dams, rock excavation, concrete walls, foundations, etc.:

| | |
|---|---|
| *Canadian Contracts, Ltd., Toronto | $19,341.00 |
| Williamson Construction Company | 19,923.75 |
| Blair & Hill | 21,000.00 |

"B," Hydraulic Machinery, including 1,100 horse-power turbine, 35 horse-power turbine, governor, penstock, etc.:

| | |
|---|---|
| *Wm. Kennedy & Sons, Owen Sound, Ont.. | $ 8,100 |
| Morgan & Smith | 9,000 |
| William Hamilton & Sons | 8,850 |
| Jenckes Machine Company | 7,592 |
| Allis-Chalmers-Bullock, Ltd. | 13,190 |

"C," Electrical Machinery, including generator, exciter, switchboard, etc.:—

| | |
|---|---|
| *Canadian General Electric Co., Toronto.... | $6,724 |
| Chapman & Walker, Toronto | 9,150 |
| Kilmer & Pullen Company, Toronto | 7,200 |
| Allis-Chalmers-Bullock, Ltd. | 6,975 |
| Westinghouse Electric Company | 7,625 |

* Accepted.

BERLIN.—For the construction of a paved roadway on King Street, between Water and Scott Streets, the following tenders were received:—

| | |
|---|---|
| General Cont. Co., curb to curb, creosote block.... | $36,700 |
| Henry Dotzenroth, curb to curb, vitrified brick..... | 38,228 |
| " " curb to curb, asphalt block ..... | 43,695 |
| " " Scoria between rails, asphalt block | 48,695 |
| " " brick between rails, asphalt block | 42,195 |
| Warren Bit. Co., brick between rails, bitulithic..... | 31,200 |
| " " brick between rails, sheet asphalt.. | 30,125 |
| " " brick between rails, bitulithic..... | 32,300 |
| " " brick between rails, sheet asphalt.. | 31,225 |
| Blight & Fielder, curb to curb, vitrified brick ..... | 34,358 |
| " " " brick between rails, asphalt block. | 37,540 |
| " " " curb to curb, asphalt block..... | 39,939 |
| " " " Scoria between rails, asphalt block | 43,122 |
| John McGuire, curb to curb, vitrified brick..... | 36,800 |
| Godson Const. Co., curb to curb, vitrified brick..... | 41,887 |
| " " " brick between rails, sheet asphalt | 37,400 |
| " " " Scoria bet. rails, sheet asphalt.. | 43,641 |
| " " " brick between rails, asphalt block | 41,960 |
| " " " Scoria bet. rails, asphalt block.. | 49,400 |
| John Conn, curb to curb, vitrified brick..... | 37,246 |
| " " brick between rails, asphalt block..... | 40,746 |
| " " curb to curb, asphalt block ..... | 41,946 |
| " " Scoria between rails, asphalt block.... | 42,946 |
| Excelsior Const. Co., curb to curb, vitrified brick.... | 36,698 |
| " " " curb to curb, asphalt block.... | 41,755 |
| I. M. Clemens, curb to curb, vitrified brick ..... | 37,716 |
| Const. & Paving Co., curb to curb, vitrified brick.... | 35,300 |
| " " " " brick bet. rails, sheet asphalt.. | 33,500 |
| " " " " Scoria bet. rails, sheet asphalt | 39,380 |
| " " " " curb to curb, asphalt block.... | 46,373 |
| Forest City Paving & Construction Co., concrete.... | 23,430 |
| " " " " " creosote block | 35,077 |
| " " " " " curb to curb, vitrified brick | 32,605 |

The contract was given to the Warren Bituminous Paving Company, of Toronto, at $32,300, for bitulithic material Their tender provides for a 5-year guarantee, according to specification.

HAMILTON.—The Smart-Turner Machine Company were recently awarded the following contracts: Prince Edward Island Railway, duplex outside packed plunger pump; Northern Crown Bank, Toronto, automatic feed pump and receiver; the Ontario Iron and Steel Company, a vertical centrifugal pump; the Kirkfield Portland Cement Company, a side suction centrifugal pump.

KINGSTON.—Michael Sullivan, of Kingston, was awarded a contract for masonry and carpentery, in connection with new chemical building, at $59,634.

OTTAWA.—The contract for the ten circuit repeater switchboard and storage battery was awarded to the Northern Electric and Manufacturing Company of Montreal, for $8,497.

**Manitoba.**

BRANDON.—Mr. James A. Fouch and W. Adam Folty, the erecting engineers for the Laclede-Christy Clay Products Co., of St. Louis, Mo., and the Kerr-Murray Manufacturing Co., of Fort Wayne, Ind., are here in connection with the installation of the new gas plant of the Brandon Gas and Power Co., the former company having the contract for the retort benches and their complete installation, and the latter company for the supply and erection of all the general machinery, including exhausters, condensers, scrubbers, and purifying boxes, with all necessary pipes and connections.

**Alberta**

LACOMBE.—Contracts for an auxiliary steam plant at the new power house and for the repairs to the dam, to cost $4,000, were awarded at a recent council meeting. The engines and boilers will be supplied by the Waterous Engine Works Co., of Brantford, Ont., and Councillor Mobley, will supervise the repairs to the dam.

**British Columbia.**

NELSON.—The Nelson Iron Works have been given a contract for the iron work required in the construction of a bridge over the Slocan River at Slocan Junction, giving connection between Thrums and Slocan Junction, and forming a link in a through road from West Robson to Nelson. The bridge will be 213 feet in length and will cost $10,000. The Provincial Government is doing the work.

VANCOUVER.—The contract for fifty miles of wire-bound wood pipe for the municipality of South Vancouver, to cost $70,000, has been awarded to the Municipal Construction Co., of this city. This is by far the largest contract for wood pipe ever placed with one firm in Canada.

## LIGHT, HEAT, AND POWER

**Ontario**

BROCKVILLE.—Brockville's civic light and power department closed its fiscal year on September 30th, and from the report just published it is found that the receipts during the year were $51,915.36. The operating expenses were $43,453.33, leaving a balance of $8,462.03 profit. From this debentures amounting to $7,597.32 were paid, leaving a net gain of $864.71. The plant was purchased nine years ago, and since then gas and electric light has been reduced from $2 to $1.12½ net per 1,000. The population of Brockville is 8,950.

GALT.—Mr. Edward B. Merrill, consulting engineer, of Toronto, has reported to council, fixing the value of the electric lighting plant which the Galt Gas Co. has offered to sell to the corporation as a distributing plant in connection with the Hydro-Electric Power scheme. Mr. Merrill finds that the value of the plant proper is $63,000, according to the original cost, with deductions for depreciation, $44,000, and, so far as it would be directly available for Hydro-Electric power purposes, $35,000. The report was referred to the Light Committee.

OTTAWA.—The council of the village of Eastview favor the installation of an electric light plant to supply the whole village with electricity at $15 per horse-power per year.

TORONTO.—A board of arbitrators has been sitting at Toronto for several days to determine the value of water privileges on River Winnipeg, of which the Hudson's Bay Company and the Keewatin Power Company were expropriated by the town of Kenora. The undeveloped water power rights were valued by Mr. Alexander Pringle, M.C.S.C.E., and Mr. Wm. Kennedy, Jr., M.C.S.C.E., both of Montreal, as well as by Mr. Clement Herschell, C.E., of New York. The valuations were $5,000 to $10,000; $10,800 and $48,000. The arbitrators will resume the hearing on January 4th, 1910.

TRENTON.—The by-law submitted to the ratepayers for the purpose of validating an agreement handing over the water power franchise to the Trenton Electric & Power Company was defeated by a majority of 239.

**Manitoba.**

BRANDON.—Engineer Harper, who is supervising the installation of gas in this city, expects that the remainder of the mains will arrive about the end of this week, when the work of laying the pipes for the present season will be resumed. Work on the new steel gas-holder is in full swing and satisfactory progress is being made. Mr. James A. Fouch and Mr. W. Adam Folty, representatives of the Laclede-Christy Clay Products Co., of St. Lewis, Mo., and the Kerr-Murray Manufacturing Co., of Fort Wayne, Ind., who have contracts for equipment and machinery, arrived here a few days ago, and the work of construction will now be pushed to completion.

**Alberta**

LACOMBE.—By the end of the month the new electric light plant now under construction will probably be completed. Contracts have been awarded to Councillor Mobley for repairing the dam at a cost of $4,000, and to the Waterous Engine Works Co., of Brantford, Ont., for an

auxiliary steam plant. Mr. E. J. Tett has been appointed manager of the plant.

**British Columbia.**

KAMLOOPS.—The report of the electric light committee on the proposals submitted by the Shuswap Power Company was adopted at a recent council meeting, the report recommending that a counter proposal be made the company, of $30 per annum per kilo on a peak load of 225 kilos, the whole matter to be subject to the approval of the consulting engineer, Mr. H. K. Dutcher, of Vancouver, B.C.

## RAILWAYS—STEAM AND ELECTRIC.

**New Brunswick.**

FREDERICTON.—Surveys have been commenced for a new branch railway in York county, and when completed the new road promises to be an important adjunct to the C.P.R. system in New Brunswick. The new railway will be about fourteen miles in length, and will run from Millville, on the Gibson branch of the C.P.R., through Temperance Vale, and out to Southampton, following the course of the Nackawick valley, and thence up the eastern end of the Pokiok bridge across the St. John River. A staff of engineers in charge of Chief Engineer Holt is now engaged in making the surveys, and if actual work is not started this winter it will commence with the first opening of spring.

**Ontario**

LONDON.—Track elevation in London has been the subject of much talk here during the past few days. A letter received by the mayor from the Dominion Railway Commission stated that the Board desired to be informed of the position of negotiations between the city and the railway company regarding the elimination of level crossings. In his letter Mr. J. P. Mabee, Chief Commissioner of the Railway Board, said: "The legislation of last session contemplates this Board initiating steps towards the abolition of level crossings, but before taking these in London it would like to be informed of what has been done by the city council looking towards the elevation of the Grand Trunk tracks through the city. It is thought by authorities that track elevation in London will involve an expenditure of $250,000. Since January, 1900, twenty-five railway accidents have occurred on the streets of London.

TORONTO.—The C.P.R. Co. desire to make some changes in the plans for the proposed high-level bridge on Queen Street East. They suggest that instead of putting in a solid fill trestle work should be permitted. The company also suggested an alteration in the floor system. In these alterations it is hoped to cut down the cost of the bridge by about $18,000.

TORONTO.—It is stated on good authority that Mackenzie & Mann have added another to their string of Ontario railway properties, by purchasing the Irondale, Bancroft and Ottawa Railway. This line which is about 50 miles in length, runs from Kinmount Junction on the Grand Trunk's Lindsay-Haliburton branch to within a few miles to Bancroft, in the northern part of Hastings County. It has been in operation about 20 years.

**Alberta.**

CALGARY.—Six new tracks two thousand feet long, which the C.P.R. are adding to their sidings here, will be completed in a day or two.

**Saskatchewan.**

LEBRET.—The G.T.P. surveyors are back from Regina, to which point they have surveyed a new line from Balcarres. Mr. Wilkie is in charge.

**British Columbia.**

NEW WESTMINSTER.—The British Columbia Electric Railway Company recently announced that their line would be extended to the Fraser River mills.

PHOENIX.—Mr. J. B. Tierney, of W. P. Tierney & Company, has charge of the construction of a branch line of the C.P.R., from Phoenix to Wellington Camp. Mr. H. B. Walkem, of the C.P.R. engineering staff, is directing the work, which is to be completed by February 1st, according to the contract.

PRINCE RUPERT.—Contracts are let on the G.T.P., and grading is under way between Kitselas and Hazelton, 80 miles. This work is considerably lighter than that of the lower part of the river and the contracts let are consequently much larger. It is not expected that anything can be done toward starting work beyond Hazelton this year. Following is a list of the contractors and the mile at which their work begins:—McDougall & Rankin, 102; D. A. Rankin, 112; M. Sheedy, 122; Moran & Chiene, 124; A. L. McHugh, 138; P. Salvus, 142; Bostrum & Kullander, 145; Sheedy & Paget, 155; Dan Stewart, 159; Norman McLeod, 162; Freebery & Stone, 8-172; Foley, Welch & Stewart, 5-175; Duncan Ross, 3-178.

**England.**

LONDON.—The Government has decided to grant $675,000 towards the Collooney & Blacksod Bay Railway. When this is constructed London will be only fourteen hours from Blacksod Bay, from which Halifax, Nova Scotia, is distant only three and a half days.

## CEMENT—CONCRETE.

**Ontario.**

HASTINGS.—The concrete landing pier at the dam is now completed as far as the cement part is concerned. The iron tie posts have been bedded in the concrete and everything is ready for the dredge to come along in the spring and rip out the strip of rock which was the old water front and was used as a coffer dam while the wall was being laid.

## SEWERAGE AND WATERWORKS.

**Ontario.**

TORONTO.—The Board of Control is considering the installation 11,137 feet of new water main with 36 hydrants.

OTTAWA.—The village council of Eastview are considering plans for a drainage system. Mr. Charles H. Keefer, M. Can. Soc. C.E., of Ottawa, who reported on the main sewers of Ottawa some years ago, has been advising.

**Alberta.**

HIGH RIVER.—Waterworks will probably be installed here very shortly. The question is receiving much attention.

## FINANCING PUBLIC WORKS.

**Ontario.**

LINDSAY.—About New Year's Day the ratepayers of Lindsay will vote an a by-law to provide $55,000 for schools.

TORONTO.—In Sept. last we stated that City Engineer Rust had prepared a report on the proposed Bloor Street viaduct and estimated the cost of two bridges, grading, paving and engineering at $619,000. This figure did not include land damages. The question was revived again at a meeting of the Board of Works last week, and the board decided to recommend to the City Council that a by-law to include $150,000 for land damages be submitted at the January elections.

**British Columbia**

VANCOUVER.—By the corporation of the township of Richmond tenders are invited for the purchase of $275,000 waterworks and $75,000 road improvement debentures up to December 1st. S. Shepherd, C.M.C., Rural Route No. 1, Eburne, B.C.

## MISCELLANEOUS.

**New Brunswick.**

ST. JOHN.—The City Council decided at a recent meeting to engage as assistant to Mr. William Murdoch, the city engineer.

**Quebec.**

MONTREAL.—On Monday, Mr. G. W. Stephens, of the Montreal Harbour Commission, outlined the scheme planned for harbour development here. Briefly it is expected to make water porterage possible by lessening the currents; to give water access by way of the canals to Western Canada and the United States; to create manufacturing and warehousing sites having direct rail connections over all lines with every port of the continent; to reduce the handling charges

on every ton of freight coming to the port. The scheme will probably cost $12,000,000. The project is to be laid before Parliament at this session.

MONTREAL.—Arrangements have been completed for the establishment of a drydock at Levis, Que., according to a cable from the Old Country, received here on Monday. The interests involved are the Canadian Pacific, the Allans, Harland & Wolff, the Belfast Shipbuilding Company; Sir Charles MacLaren, representing John Brown & Company, of Sheffield; Mr. Davis, of Levis, who conducts the present salvage and drydock business there, and the McArthur-Perks Co. of Canada. The same interests have made a definite proposal to the Canadian Government, which they expect will be accepted, for a drydock in St. John. The constructors have decided not to erect this drydock at the Canadian Pacific wharf in St. John, but somewhere around Partridge Island.

**Ontario.**

HAMILTON.—A new bolt and bar mill will be built here in connection with the Hamilton Steel and Iron Company. The expenditure for new works will be large.

OTTAWA.—While a definite conclusion will not be reached until next week, it is regarded as likely that the new Quebec Bridge will be built upon the cantilever, rather than suspension principle.

WELLAND.—A new industry, the Electro Steel Company of Canada, is to locate here. The site embraces fifty acres. The officers are: President, Tyson S. Dines, St. Louis, Mo.; vice-president, George S. Goodrich, Saratoga, N.Y.; secretary, A. S. Ragame, St. Louis, Mo. The capitalists behind the enterprise are Pittsburg men, who have large interests in the United States steel and iron trade. The billet mill, for which the contracts are placed is on the south side. Five steamers are chartered to deliver cargoes of ores from the Lake Superior mills before the close of navigation.

**British Columbia.**

VANCOUVER.—The Dominion Wire Manufacturing Company, of Montreal, is locating in Vancouver, and will manufacture wire nails for the trade on the Coast.

VANCOUVER. — The Pacific Creosoting Company, of Seattle, has secured a site on Burrard Inlet and will establish a plant. Several Vancouver capitalists are associated.

VANCOUVER.—The D'Olier Engineering Company, of Philadelphia Pa., have an expert here in connection with the tests that are being made of the high pressure pumps.

VANCOUVER.—After having spent four seasons in survey work in northern British Columbia waters, being principally engaged in surveying the various deep-sea approaches to Prince Rupert, the coast survey ship H.M.S. "Egeria" returned from the north last week in charge of Captain Parry.

VICTORIA.—City Engineer Topp recommended the purchase of street flushing machinery at a recent meeting of the council, who are considering the question of street cleaning.

## PERSONAL NOTES.

MR. E. J. TETT has been appointed manager of the new power plant at Lacombe, Alta.

MR. JAMES WHITE, who has been Dominion Geographer since 1884, was recently appointed secretary of the Commission for the Conservation of Natural Resources, which was sanctioned last session. Mr. E. R. E. Young will probably succeed him as geographer. Mr. Young left for England last Monday to attend the International Geographical Congress.

## OBITUARY.

MR. ALEXANDER COMPTON, a well-known contractor, formerly of Charlottetown, P.E.I., was drowned near his home at Flat River, P.E.I., on November 15.

MR. GEORGE H. PEDLAR, only son of Mr. George H. Pedlar, sr., president of the Pedlar People, Ltd., of Oshawa, died on Monday, at the General Hospital, Toronto. Mr. Pedlar was thirty-six years of age.

## WATER METERS FOR TORONTO

In referring to the consumption and waste of water, at a meeting of the Canadian Society of Civil Engineers, held in Toronto on Monday evening, Mr. Allen Hazen, consulting sanitary engineer, of New York, said that Toronto would have to curtail the great waste of water by the installation of meters. Mr. Hazen quoted figures and showed diagrams illustrating how this had affected the amount of water consumed in European and American cities where the plan had been adopted. There are about sixty thousand water services in Toronto, with less than three thousand meters in use, and to install meters costing $12 each would involve an expenditure of $720,000, said Mr. C. L. Fellowes, the waterworks engineer, who believed that it would be an economy in the end.

Dr. Sheard, the medical health officer also thought that meters should be installed. The average daily consumption of water per capita in Toronto last year, was 90.1 gallons.

On the 26th March, 1909, The Canadian Engineer published an article containing statistics affecting some thirty or forty cities in Canada where waterworks have been installed. The information gathered showed that the consumption of water varies from 25 to 283 gallons per capita per day, a remarkable variation. Figures showing the effect of meters and reflecting the conditions existing in other countries were also given.

## MARKET CONDITIONS.

Montreal, November 16th, 1909.

Advices from Pittsburg are to the effect that makers and sellers of pig-iron do not seem to be looking forward to any very heavy buying for delivery during the balance of the year 1909. It would seem that practically all the large buyers in the district are pretty well covered for their requirements for some time in advance, occasional filling orders being about the only business in view for the next month or so. In addition to this, many customers have now made their purchases for delivery over the first quarter of 1910, and there is little doubt that in some cases purchases have also been made for the first half. There are also reports to the effect that some contracts for foundry iron have been made for second half 1910, but such business is very rare. There are many instances, on the other hand, it is stated, of furnaces which have not as yet accepted orders from their general customers for first quarter and a much greater number have refused to do business on the present basis for later than July first. One of the strongest arguments in favor of high prices is the assurance that higher prices will have to be paid for coke, so that $17.50, valley, for No. 2 foundry for forward shipment is little more than equal to $15 on a basis of present cost of production. It looks as though the consumption of iron in many quarters is greater than was expected at the time contracts were made, so that the situation seems to be quite firm, throughout.

Mail advices from Glasgow state that the tendency of the pig-iron warrant market has been a little reactionary, with a restricted business at gradually receding prices. Quotations, however, continue fairly steady, and holders are fairly confident, notwithstanding the prospects of dear money. There is practically no change in either the home or continental demand, but advices from the United States continue strong and hopeful regarding the future.

Shipments from Middlesboro for the ten months ending October 31st amounted to 1,018,145 tons, against 1,127,900 for the corresponding period of 1908; 1,507,437 tons for 1907; 1,239,787 for 1906. In 1899, shipments amounted to 1,148,521, but for the intervening years, the shipments were smaller than for the present.

Shipments are now very large in the local market and, in fact, importers seem to think that, in the matter of the tonnage of iron brought into the country, it is not impossible that the present year may turn out to have made a new high record for Canada. From now till the turn of the year, it is not likely that a great deal of new business will be done, and after the end of this month it cannot be expected that shipments will amount to much. Meantime, not only in pig-iron, but in all lines of hardware and iron and steel products, there is much activity, every one being anxious to take advantage of the low water freights. The market continues quiet, so far as price changes are concerned, however, as the following list will show —

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.00 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90, imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows: 1¼ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c. 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch)

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton,

net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars, at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 4-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are firmer at $2.45 per 100 pounds, base of 5/16 x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32½ to 33c.

**Zinc.**—The tone is steady, at 6 to 6¼c.

* * * *

Toronto, November 18th, 1909.

One might suppose, from the continuous demand in Toronto for lumber for dwellings that prices must be firm to the point of advancement. But much of this which moves is of a lower grade, which indeed is offered freely at prices below present cost of production. And it can hardly be that the erection of cheap dwellings will continue at such a pace as has characterized the past year or two. Even speculative builders must learn that there are a great many buildings vacant. There is much lumber on hand outside the city, which will prevent a rise of price in the immediate future.

The iron market is firm, and in some grades prices higher. Founders are looking for pig but hardly willing to pay advanced prices. Structural steel in the States is very firm and some shapes are higher. Other metals are, as a rule, steady in price. Extraordinary activity exists in automobile factories in the States, which are ordering largely of certain shapes of steel for future delivery.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady.

**Coal.**—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50.

**Copper Ingot.**—Demand quite heavy, and price advanced to 14¾c. Supply adequate.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite**, per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs. Much is being now used for lumber camps.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, weak, and rather over-stocked, $3 to $3.10; lath, No. 1, $4.40, white pine, 42-inch; No. 2, $3.75; for 32-inch, $1.60.

**Nails.**—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—Dealers report a large demand, the prices being as before, per catalogue

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100

# The Canadian Engineer

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## The Canadian Engineer

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## RAILWAY BUILDING IN WESTERN CANADA.

The year 1909 has established a record for railroad construction in Western Canada. Twenty-eight millions have been spent on construction work alone. Supplies and material involved an expenditure of a further 28 millions. And who can count the millions spent by the settler, the small merchant, and the builder, all because the railroad has created new markets, new towns, and new outlets.

The C.P.R. completed the second track from Winnipeg to Fort William, and incidentally doubled the capacity of the "spout." They shortened the mountain section by the Field spiral tunnels, and forged the last link in the third trunk line from Winnipeg to Edmonton. As if that was not enough, they built branch lines here and there, reaching out for the great Western trade.

The C.N.R. constructed a line into the Goose Lake country. They are pushing westward from Midale.

The G.T.P. opened the third transcontinental across the prairie to Edmonton and extended it to the Yellowhead, and already the construction of branches both to the north and to the south has been commenced.

Next year the railway race will be even more apparent and more strenuous. The C.N.R.-McBride agreement indicates the extensive plans of the C.N.R. in British Columbia. The line from the Yellowhead Pass to Kamloops, down the Fraser Canyon to Vancouver, will be expensive to build, but will open up a large, new district. The C.N.R. will also continue their Midale line towards, if not into, Lethbridge. Lethbridge is to-day the object point not only of the C.N.R., but also from the south, the Great Northern, who are pushing a line in that direction. The Weyburn line of the C.P.R. is also heading that way.

The G.T.P. will next year have very heavy work on their mountain section, and in addition they will construct their Wainwright-Calgary branch, which will give them access to Southern Alberta. Next year the West will be overrun with an army of engineers, contractors and navvies—and this fight will continue until the railroads are able to handle, without congestion, the output of the plains.

## FLOW OF STREAMS.

Much money has been spent in Canada on hydro-electric plants—unfortunately, much of it misspent. It is the exception to find developed water powers that have not been over-developed, with the result that many companies and municipalities find they have available only a fraction of the power on which they calculated.

When a stream is under consideration as a source of water power the minimum, maximum and total flow of the stream for the several seasons of the year and the average of several years are among the first informa-

tion required. Usually, too, this information, which is so valuable, is required very quickly. There is no time for a long series of gauging, and the engineer must estimate as best he can the minimum flow from whatever information is available.

So many factors enter into the question of stream flow—the drainage area, the character of the soil, rock and vegetation on that area, the contour, the elevation and the location—that the problem is too intricate for the private individual to fully solve.

After watching with considerable interest the support given by municipalities and Provinces to public ownership ventures, and noticing the effect such movements had upon the individual initiative, we venture the opinion that if more attention and more money had been given to experiment, if the Governments had conducted investigation as to stream flow, rate of evaporation, effects of ponding on stream-flow, percolation and other elements that enter into this problem, they would have done a greater service to the people.

So many of the questions require years of study and careful observation that the consulting engineer cannot undertake the work. His clients want a report now—not three years hence. It is true that in the Northern States of the American Union much good work has been done under somewhat similar conditions, and using their conclusions fair results may sometimes be secured. But conditions here are not altogether similar. The months of frost and snow are longer, the vegetation and summer temperature more varied, and the rate of evaporation and percolation very uncertain quantities.

This work is all the more necessary because of the many blue books and reports that have been issued, and are being issued, in which **estimates** (?) of Canadian water powers are given. The statistics are compiled to attract capital, to make known our great wealth of water power—and rightly so. But too frequently descriptive figures are taken for exact calculations, with unfortunate results.

Mr. R. S. Lea, M. Can. Soc. C.E., in Quebec, and Mr. W. H. Breithaupt, M. Can. Soc. C.E. in Ontario, have done good work in bringing the attention of governing bodies to these questions, and if Canadian water powers are to be developed—and not exploited—the Government should employ a permanent staff to investigate and report upon matters affecting stream flow. It is done in Alberta and Saskatchewan. Why not in the other Provinces?

## EDITORIAL NOTES.

For several months we have been busy compiling a complete list of manufacturers of contractors' supplies and equipment for engineers. On page 6 of this issue appears an index to catalogues devoted to machinery and equipment of many kinds. If you require new machinery or new equipment, we can put you in direct communication with reputable manufacturers, if you will send us the index number. We want to be of service to you.

* * * *

The next few years will see the linking up of the Peace River and Athabasca districts to commerce and its markets. The men who have waited twelve years for the railroad, the railroad men themselves, and those who see into the future any distance at all will obtain the primary benefits.—The Monetary Times of Canada.

## LOCOMOTIVE COUNTERBALANCING.*

By Mr. H. H. Vaughan,
Assistant to Vice-President, C.P.R., Montreal.

The counterbalancing of locomotive engines is one of the few problems in connection with that apparently simple yet exceedingly complex machine which are capable of an exact theoretical determination.

When the weights, locations, and movements of the various parts of an engine are known, it is possible to calculate accurately the forces which they cause at any speed of rotation, and apart from some practical considerations, such as the engine being constricted in its lateral movements by the wheels which support and guide it on the rails, and the fact that it is connected in a more or less imperfect way with a tender, the movements which result from the action of these forces can also be exactly ascertained; this subject has consequently been very thoroughly treated by a number of writers, and I shall therefore endeavor to discuss, as shortly as possible, the theoretical principles which underlie it.

The disturbing forces which necessitate the counterbalancing of any reciprocating engine are those required to start and stop the mass of the reciprocating parts at each

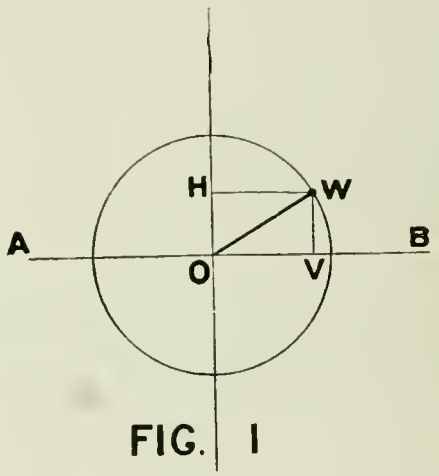


FIG. 1

end of the stroke; neglecting the disturbance caused by the obliquity of the connecting rod, which is unnecessary to consider in any existing type of locomotive, these forces are identical with that caused by a corresponding mass at the crank pin, with the exception that they have no vertical effect.

In Fig. 1 let the weight W be rotating round the centre O, at a velocity of V feet per second; then what is known as the centrifugal force, which is really the force that is required to make W move in a curved line instead of in a straight line, as it would do if left to itself, acts along the line W O, and equals $\frac{W V^2}{32.2 r}$ when r is the radius in feet.

This force W O can be resolved into two components W H and W V, the first acting entirely in a horizontal, and the other in a vertical direction; it will be seen that when W is on the vertical diameter W H is nothing, while W V equals W O, and when it is on the horizontal diameter W H equals W O while W V is nothing. Now, if the weight W moved backwards and forwards along the horizontal line A B in such a way that its position on that line was always vertically under or over the position of W when rotating uniformly

*Read before the Central Railway Club.

around the centre O, the force necessary to accelerate or retard it is always W H, or, in other words, equals the horizontal component of the centrifugal force due to an equal weight rotating in a circle.

This is what happens in the case of a weight such as a piston and crosshead actuated in a horizontal line by a connecting rod, as in Fig. 2; here the distance of the weight P from the centre of the stroke corresponds with the horizontal distance of the crank pin C from the centre O, and the force accelerating or retarding it is equal to C H when C O equals the centrifugal force which P would exert if moving on the path of C.

Since P in this case is moving entirely in a horizontal plane, it gives rise to no vertical forces whatever, and it is

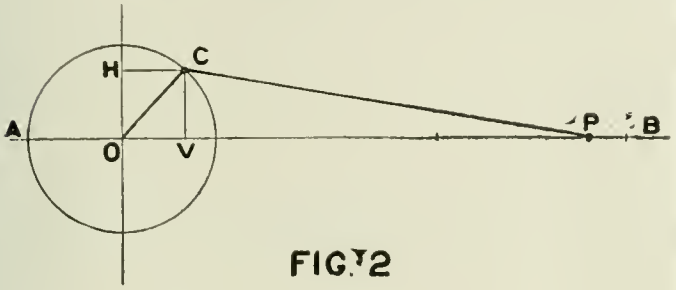



FIG. 2

this fact that introduces all the difficulties in connection with balancing an engine; before, however, discussing that question, the connecting rod must be referred to. It is evident that this has at one end a circular, and at the other a reciprocating movement, while between the ends, the motion of any part is of an intermediate nature; the result is the same as though part of its weight were concentrated at the crank pins and had a circular motion, while the remainder was concentrated at the crosshead and had a reciprocating motion.

In a paper read before the Northwest Railway Club, in 1893, I suggested that four-fifths of the weight of the back end should be taken at the crank pin, and the weight of the front end and one-fifth of the back end at the crosshead, figures that were obtained by calculations from two or three types of rod; this question was, however, treated in an exceedingly ingenious and scientific way in a paper read before the New York Railway Club, by Mr. R. A. Parke.

He developed an accurate method for obtaining the exact division of weights for any rod, and his results showed for modern types of rod that five-sixths of the weight of the back end of the rod should be considered as concentrated at the crank pin with reasonable accuracy. I would refer anyone interested in this subject to his paper, as it is a most interesting example of the application of a really difficult mathematical analysis, by which an absolutely simple method is deduced for obtaining correct results. I consider, however, for practical purposes, that five-sixths of the weight of the back end is sufficiently accurate, and that figure is used on the Canadian Pacific.

There is one more elementary statement to make, namely, that a weight of W pounds at a radius 2r has the same effect as a weight of 2W pounds at a radius r; this follows immediately from the value of the centrifugal force $\frac{M V^2}{32.2r}$, for with the same number of revolutions V is proportional to r, so that for equal forces Mr must be a constant. For simplicity, therefore, all balance weights will be assumed to be placed at the same distance from the centre as the crank pin.

With these facts in mind, let Fig. 3 represent an ordinary engine, and let all the rotating weights be concentrated at the crank pin W, say 1,000 lbs.; let the reciprocating weights be concentrated at the crosshead at P, say 1,500 lbs. The rotating weight can be balanced by a weight of 1,000 pounds placed at C, diametrically opposite W on the other side of the centre; evidently, whatever be the position of the crank, the forces caused by the two weights are equal and opposite, and there is no resulting force to disturb the axle at O.

When, however, attempting to balance the 1,500 lbs. at P, by placing 1,500 lbs. at C, the condition is entirely different; the horizontal forces caused by the movement of P are exactly equal and opposite to those caused by the 1,500 lbs. at C, but as no vertical forces are caused by P's movement, the vertical forces caused by the movement of the 1,500 lbs. at C are left entirely unbalanced, and the effect is the same as though a weight of 1,500 lbs. at C were entirely unbalanced vertically.

Whatever weight then is introduced at C to balance the horizontal forces caused by P, causes vertical forces equal in amount to the extent by which those due to P are reduced; there is no possible combination by which this can be avoided, except by using crank pins that are not at right angles to each other.

For instance, if there were a crank pin at C and a connecting rod as shown by the dotted line C L, then if the weights at L and P were in substantially the same plane and equal, they would practically balance each other, as is the case with four-cylinder engines, which can be almost perfectly balanced without introducing any vertical forces, while three-cylinder engines can be balanced longitudinally, but are, with respect to nosing, almost in the same class as two-cylinder engines. The latter are the engines now under consideration, and in their case the question of counterbalancing is a compromise.

If P is left unbalanced the engine is said to be badly balanced, if P is completely balanced the engine is said to be well balanced, but vertical forces are introduced which certainly may be injurious to track or bridges.

The extent of the force due to any unbalanced weight may be calculated at any speed, but is usually taken at 40

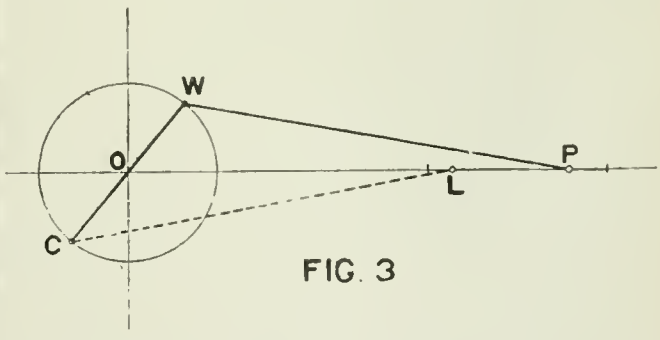



FIG. 3

times the weight when the speed in miles per hour is equal to the diameter of drivers in inches; it really varies with the stroke; and the exact figures are 38.5 for a 24" stroke, 41.7 for a 26", and 44.9 for a 28"; taking 40 for an approximate figure, 500 lbs. at C above that required to balance the rotating weights, or, as it is termed, "as overbalance," means a force of 20,000 lbs. acting upwards and downwards at each revolution, and while this seems a high figure, it is occasionally found.

The speed of 69 miles per hour is high for a 69" wheel, but it represents a possible condition, and it must be remembered that while the factor of 40 is not reached until that

speed for that size of wheel, that it increases with the square of the speed, so that it is not advisable to consider a lower speed.

Evidently, then, it is desirable to keep the overbalance as small as possible, and yet on the other hand the reciprocating parts must be partially balanced for the comfort of the men, and the various rules of counterbalancing have really indicated the nature of the compromise.

The rule most commonly used in America has been that recommended by the committee on the subject at the M.M. Convention in 1882, in which two-thirds of the reciprocating parts are balanced; this compromise has, on the whole, given very satisfactory results, and constituted a great advance on one of the methods given as an answer to the inquiry made by the committee, which was "to figure a little and then guess at it."

The two-thirds rule, however, is not necessarily satisfactory; it proves so in the majority of cases, because the relations between the weight on drivers, weight of engine, and reciprocating parts do not vary greatly in engines of ordinary types, but the first great advance was made when Mr. G. R. Henderson, in a report made to the Norfolk and Western Railway, in 1895, pointed out that the allowable weight of unbalanced reciprocating parts was a factor of the weight of the engine.

Assuming only, that the maximum speed is proportional to the diameter of the drivers, and that it is desired to construct engines that will be reasonably comfortable for the men at that speed; in other words, that will vibrate to the same amount, then evidently the disturbing forces, or the weights of the unbalanced parts, may vary in direct proportion to the weight of the engine.

Mr. Henderson showed that engines in which $\frac{1}{400}$ of the weight of the engine was unbalanced rode satisfactorily, and that $\frac{1}{360}$ can be left unbalanced without objectionable vibration; we have then in this rule a scientific method of determining the weight of reciprocating parts that may be left unbalanced, and yet allow the engine to ride reasonably well, which is applicable to engines of widely varying types; for instance, if two engines were of the same weight, but one had reciprocating parts weighing twice as much as those on the other, this rule would allow the same weight to remain unbalanced; in other words, both engines would ride equally well, whereas with the old two-thirds rule one engine would have twice as much unbalanced weight as the other.

So far as the action of the engine is concerned, there is, I consider, no criticism possible that can be made of this rule; in other words, an engine balanced by it is certain to ride satisfactorily, but in balancing an engine there is another and very important aspect of the matter which it ignores, namely, the effect of the overbalance on the track. This side of the question has often been referred to, and its effect discussed in a general way, but so far as I am aware, locomotive builders have never really established any rule limiting its amount, although they have recommended balanced compound engines or the utilization of the weight of the tender, which I shall refer to later. On the other hand, no maintenance of way engineer has, I believe, defined the limit of overbalance which he considers permissible, although he will cheerfully advocate none being used; neither is he able, except in extreme cases, to show any definite evidence of damage from this cause.

Taking, however, the maximum speed before referred to, an overbalance of 500 lbs. in a wheel carrying 20,000 lbs. causes the pressure between that wheel and the rail to vary from 40,000 lbs. when the overbalance is down to nothing when it is up, and any greater overbalance would tend to lift the wheel from the rail.

Testing plant experiments show that when the calculated effect of the overbalance exceds the weight on the wheel that it does actually leave the rail, and that there is a definite blow when it strikes it again.

I have analysed this action (see "American Engineer" for February, 1909), and have shown that this blow may, in extreme cases, be severe and sufficient to account for the damage that is occasionally met with; on the other hand, I do not believe that any case of repeated bending of rails has occurred in which the vertical effect of the overbalance did not considerably exceed the weight on the wheel. It is, however, only reasonable to acknowledge that a wheel that presses alternately nothing, and 40,000 lbs. on the rail, is going to effect the track more than one which presses down continuously with 20,000 lbs.

It will damage more defective rails, cause more injury to tracks, and may, in weather when the rail is unevenly supported, be the cause of rail breakages. From the track

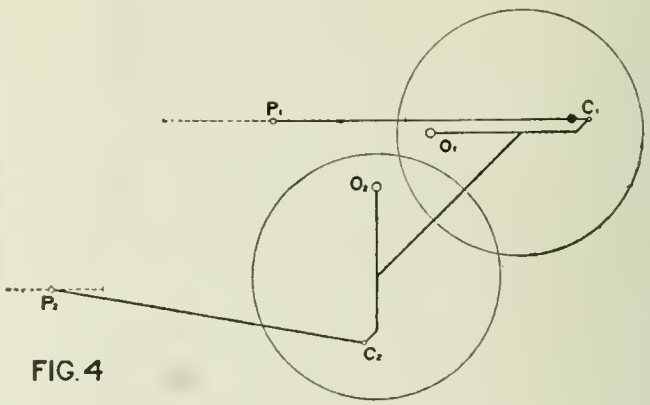


FIG. 4

point of view, therefore, the less the overbalance the better, and the problem of the locomotive engineer is to determine to what extent it can possibly be reduced. To discuss this I must refer more in detail to the action of the unbalanced weights on the engine

In Fig. 4 let $P_1$, $P_2$, be the right and left crossheads respectively, $C_1$, $C_2$, the crank pins, and $O_1$, $O_2$, the overbalances; as $C_2$ and $O_2$ are in the middle of the stroke they have no horizontal effect, and there is a longitudinal force equal to $P_1—O_1$ tending to drive the right side of the engine backward; as $P_2$ comes to the end of its backward stroke there is a similar force tending to draw the left side of the engine backward, and at that time the effect of $P_1$ and $O_1$ is nothing.

This action is repeated at the back of the stroke, so that the action of the unbalanced weight is to drive the engine backwards and forwards as a whole, and also to cause the ends of it to vibrate transversely; or, as it is usually called, "make it nose."

There are then two distinct actions of the unbalanced weight in an engine, which I will call the longitudinal and transverse movements; the latter you will agree, I believe, is not generally very noticeable, but on small 8-wheel engines it is objectionable when running at a high rate of speed.

Some years ago, when working on this subject, I noticed, as I dare say you have, that on the longer, heavier engines,

the nosing from unbalanced weights was not noticeable, and in a paper before the Northwest Railway Club, in 1896, I advocated a rule in which the unbalanced weight was increased in proportion to the length of the engine as well as to its weight. This rule was defective, as it increased the longitudinal vibrations on a long engine as compared to a shorter one of equal weight, and as the longitudinal vibrations are those which render an engine rough riding, it could not, and no rule could increase the unbalanced weight beyond a certain amount without being objectionable.

It is true that engines balanced by it rode satisfactorily, but that was because it started with a short engine with $\frac{1}{400}$ of the weight unbalanced, and on the longest engines it was applied to, did not increase the unbalanced weight beyond $\frac{1}{360}$, which is an amount that does not, as a rule, lead to criticism by the men.

Although this rule was not of much practical value, it recognized one point, namely, that the nosing motion was not as important as the longitudinal, and when investigating the counterbalancing of some engines on the Canadian Pacific, in which the counterbalances were off-set so as to increase the longitudinal, and decrease the nosing movement, it occurred to me that by allowing an increase in the nosing movement, a decrease in the amount of overbalance could be obtained without increasing the longitudinal movements.

This can be done by means of off-set counterbalance weights, but as they have a serious objection, the same result can be obtained by means of supplementary counterbalance weights placed at right angles to the cranks. This arrangement is shown on Fig. 5, $S_1$, $S_2$, indicating the supplementary counterbalances and the arrows the direction of the forces.

Neglecting the difference in the distances, centre to centre, of the balance weights and the pistons, which it is not necessary to consider here, it will be seen that the forces at $O_2$ and $S_1$ both tend to drive the engine forwards as against that of $P_2$ driving it backwards; in place of a force $P_2—O_2$ driving it backward as in Fig. 4, the force is, therefore, reduced to $P_2—(O_2 + S_1)$ on the other hand, the force $P_2—O_2$ still tends to throw the front of the engine to the right, and it is assisted by $S_1$.

The net result therefore is, an engine that is balanced longitudinally as an engine would be with an overbalance $O_2 + S_1$, and balanced transversely as though its overbalance were $O_2—S_1$. To put this into figures, suppose the engine weighs 160,000 lbs., and the reciprocating parts weigh 1,300 lbs. a side; the permissible unbalanced weight at $\frac{1}{400}$ of the weight is 400 lbs., leaving 900 lbs. to be balanced, or 300 lbs. per wheel, if the engine has six drivers; if the weight per wheel is 20,000 lbs., this overbalance is 1.5 per cent. of the weight on the wheel, and the variation in pressure at the maximum speed is 12,000 lbs. or 60 per cent.

This would not be an unusual case, in fact it would be an ordinarily well-balanced engine. Now, if we place a supplementary balance weight of 100 lbs. on the opposite wheel, and reduce the overbalance to 200 lbs., this 200 lbs., and the 100 lbs. from the other wheel, make up the 300 lbs. to balance the engine longitudinally, but for transverse balance the 100 lbs. has to be deducted from the 200 lbs. overbalance, so that only 100 lbs. is balanced in each wheel, or 300 lbs. altogether.

Taking 300 from 1,300, leaves 1,000 lbs. unbalanced transversely, or $\frac{1}{160}$ of the weight, and we, therefore, have an engine that longitudinally has $\frac{1}{400}$ of its weight unbalanced, but transversely $\frac{1}{160}$ unbalanced. The overbalance has been reduced from 300 to 200, but the reduction in the effect on the track is not quite as great as this; the greatest effect of $S_2$ and $O_2$ is not when $O_2$ is vertical, but it equals $\sqrt{(O^2_2 + S^2_2)}$ or, for the two weights in question 222 lbs., a reduction of 78 lbs., or 3,120 lbs. at the maximum speed.

I am not entirely prepared to say how far this system can be carried, but from the experiments so far, it would appear that an engine having $\frac{1}{400}$ of its weight unbalanced longitudinally, and entirely unbalanced transversely, is entirely satisfactory as far as its riding qualities are concerned. This would mean that the supplementary balance was equal to the overbalance, and in that case the effect on the track would be 71 per cent. of that of an ordinary overbalance giving the same longitudinal effect, and this reduction can be accomplished without detriment to the ordinary qualities of the engine, or without introducing any objectionable troubles.

It is true that the nosing must be prevented by the pressure on the hubs of the wheels, but against this, it must be remembered, that when balance weights are distributed amongst three or four wheels that the effect of the overbalance on the boxes of all except the main wheels is just the same as it is on the track, and that the steadying effect on the engine is obtained at the expense of wear in the boxes. The wheel base on an engine is so long, compared to the distance from the centre of the engine to the centre of the cylinder, that a very small pressure on the hub is able to overcome a nosing motion much better than a balance weight, and probably with less wear.

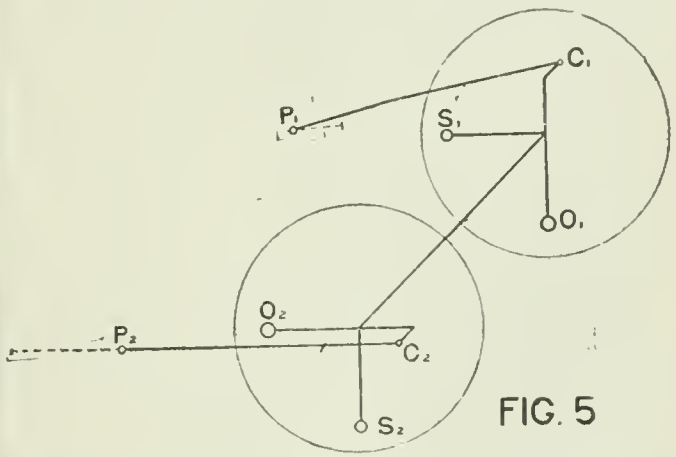


FIG. 5

We are not, however, leaving engines entirely unbalanced transversely except as an experiment, but are leaving from $\frac{1}{100}$ to $\frac{1}{150}$ of the weight unbalanced transversely, and $\frac{1}{400}$ unbalanced longitudinally with extremely satisfactory results; one passenger engine has been entirely balanced longitudinally and entirely unbalanced transversely. It is reported to be a "perfect riding engine," and its balance is exactly the

same as a 3-cylinder engine having two outside cranks each at right angles to the inside crank, and otherwise unbalanced, so that it has been shown that an engine of this kind would be entirely satisfactory as far as the balancing is concerned.

We are, however, using the system of balancing to reduce the action of the overbalance on the rail, and have adopted a rule to balance the engine so that the overbalance in any one wheel shall not, if possible, exceed one per cent. of the weight on that wheel, and is limited to 1¼ per cent.

The latter figure causes a variation of 50 per cent. of the weight on the wheel at the maximum speed, and while I have, of course, no accurate information to show that this is the proper limit, it is so much better than on many existing engines, that I feel that it is a sound limit to work to, and we are certain that under no conditions can any hammer blow occur from wheels balanced in this way. So far, no engine has been met with in which it is not possible, by using supplementary balances, to obtain satisfactory results without increasing the overbalance above this amount.

There are also one or two practical advantages in the system of allowing a greater unbalanced weight transversely. It is possible to properly counterbalance consolidations, as the supplementary weights can be placed in the wheels at right angles to the crank, thus overcoming the difficulty experienced of not being able to get sufficient balance opposite the crank without an excessive overbalance in the leaders and trailers.

It makes the adjustment of the balance very easy It is only necessary to cast the main balances 75 or 100 lbs. light, and then place 75, 100, or 125 lbs. in the supplementary balance, as is necessary to keep the longitudinal unbalanced weight down to $\frac{1}{400}$ of the weight of the engine. Extreme accuracy is entirely unnecessary, any engine that has less than $\frac{1}{400}$ unbalanced longitudinally will ride well, and apparently the transverse balancing is very unimportant.

The weights should be checked up to see that the effect of the overbalance and supplementary balance is less than 1¼ per cent. of the weight on the wheel, but this is fairly well known from corresponding engines, and in the types so far gone into, there has been no case where this figure had to be exceeded.

These advantages are, of course, incidental. The chief interest is, I consider, the fact that an engine may be unbalanced transversely to a far greater extent than longitudinally without causing its riding qualities to be objectionable, consequently, the overbalance can be reduced, and its effect on the track maintained within reasonable limits.

I have referred to the utilization of the weight of the tender. This has been done on the Prussian State Railways by coupling the engine with tender so firmly that the weight of the tender assisted in absorbing the longitudinal vibrations. If this could be done the factor of $\frac{1}{400}$ could, of course, be applied to the total weight of the engine and tender, and I understand that engines have run with the reciprocating parts entirely unbalanced with satisfactory results.

We have always found here that when less than $\frac{1}{360}$ was unbalanced, trouble has developed in keeping up the connection between engine and tender, and lost motion has occurred very quickly. I feel that, with our heavy reciprocating parts and hard service, this method is hardly practicable, and it does not afford any hope of being able to avoid some system of balancing for two-cylinder engines.

Before closing, I wish to refer to offset counterbalances, as it is obvious that the combination of main and supplementary balances I have described is the same as an off-set balance weight; the trouble with the latter is that it cannot be weighed, and must be calculated.

Some very serious errors have been introduced by depending on weighing it, especially where it is off-set, to reduce the nosing movement; in Fig. 6 let $C_1$, $C_2$, be the crank pins, $O_1$, $O_2$, the counterbalances (not only the overbalances); when weights are placed on the crank pins at $C_1$, they do not show the weight of the overbalance at $O_1$, as is the case with an ordinary balance opposite the crank; suppose the crank pin radius be 12″ and the counterbalance $O_2$ is set 4″ off the centre line; evidently the weight at $C_1$ acting at 12″ is helped by that at $O_2$ acting at 4″, and the mistake has been made of thinking this weighed the counterbalance at $O_1$; it does not begin to.

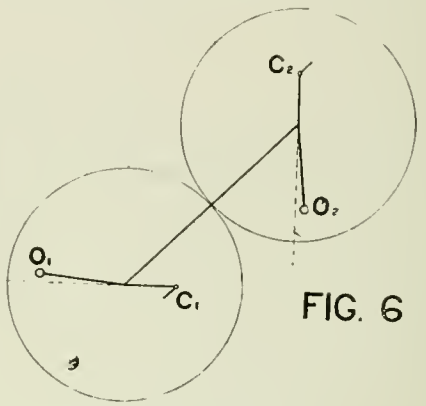


FIG. 6

$O_1$ in addition to balancing the weights at $C_1$, is balancing the entire weight of the crank pin and hub, and a numerical example will show what happens. Suppose $O_1$ is also 12″ from the centre, and that the weight of the crank pin and hub at $C_1$ is 500 lbs., and that the counterbalance desired is 400 lbs. Neglecting the fact that $O_1$ is not quite 12″ from the vertical line, it would require 900 lbs. at $O_1$ to give a counterbalance of 400 lbs. in addition to balancing the weight of the hub; this 900 lbs. would also act at $O_2$ at a distance of 4″ from the centre line, and consequently the weight required at $C_1$ to balance would be $\frac{900 \times 12 - 900 \times 4}{12}$ or 600 lbs., of which 500 lbs. is supplied by the crank pins and hub, leaving only 100 lbs. actually necessary to balance an overbalance of 400 lbs.

Evidently, this might easily be very misleading, and the difficulty is that, from the weight on the crank pin the actual overbalance cannot be calculated except by estimating the weight of the crank pin and hub, and knowing the exact off-set of the centre of gravity of the counterbalance.

For this reason the arrangement of counterbalance weights directly opposite the pin is far better, as they can accurately be weighed and the supplementary balances of known weight afterwards added.

I think that is all I have to say just at present, gentlemen, and I now declare this subject open for discussion. If any member has anything to put forward in this connection, I am sure we shall be very glad indeed to have his opinion, and if anyone has any questions to ask I will be glad to answer them.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## TORONTO WATER SUPPLY AND WASTE.

Last week Mr. Allen Hazen, lecturing upon "Slow Sand Filtration" in Toronto, called attention to the large per capita amount of water used in Toronto. He stated that if the consumption was allowed to increase at its present rate the slow sand filters at present being installed would be found inadequate.

This statement is reasonable, as slow sand filtration will only allow of limited quantities of water being treated per acre of filter, and any increase over the amount at once shows itself in loss of efficiency.

The city of Toronto must either adopt some method of decreasing its per capita rate of supply, or make up its mind to at once borrow another large sum of money for increase of the filter plant area, otherwise slow sand filtration is going to prove a failure without even giving it a fair test.

**Ten years ago** Mr. Rust (City Engineer) reported as follows:—

Extract from City Engineer's Annual Report for the year 1899:—

"This year, taking the population to be 215,000, the consumption averages 99.7 gallons per head; of this, the metered water amounts to 12.5 gallons per head. Between three and four o'clock a.m., when there is practically no consumption, water is being pumped at the rate of 15,000,000 gallons per day, or 70 gallons per head of population. Careful measurements of the discharges of the sewers, which were taken recently for sewage disposal purposes, show that the minimum quantity carried off by all the sewers was at the rate of 15,214,000 gallons per day, showing a very close agreement with the rate at which water was being pumped between 3 a.m. and 4 a.m.

"It is evident that the greater part, if not all, of this 70 gallons per head was waste water, leaving 17.2 as the quantity used for domestic purposes. That this quantity is very close to that actually used the experience of the following cities indicates: At Fall River the quantity per head for domestic purposes is 11.2; at St. Lawrence, 16.3; at Woonsockett, 14.1; at Worcester, 14; while for London, Birmingham, Manchester and Sheffield the rate per capita is from 13 to 25 gallons. So that, allowing 10 gallons per head for incurable waste (this being the amount fixed upon by Mr. Freeman in his report to the New York Water Board) and adding to this amount 12.5 gallons metered water and 17.2 for domestic purposes, a total of 39.7 gallons per head would be a fair figure for all purposes, including incurable waste. In other words, 60 per cent. of the water pumped is absolutely wasted without benefit of any kind being derived from it. It would, therefore, appear reasonable on economical grounds alone to take some measures to reduce this waste."

This straightforward and alarming report, handed in by the present City Engineer ten years ago, has been followed by a further increase in the per capita consumption.

**In 1899 the per capita consumption was 99.7 gallons.**

**In 1909 the per capita consumption is over 120 gallons.**

**In 1899 about 12,000,000 gallons per day of water were being pumped to waste.**

**In 1909 about 21,500,000 gallons per day of water are being pumped to waste.**

We respectfully ask that the Board of Control at once obtain an estimate from the City Engineer of the cost as follows:—

(a) The annual cost of pumping 21,500,000 gallons per day without benefit of any kind being derived from it.

(b) The probable annual cost of treating 21,500,000 gallons per day of waste water, represented as sewage, at the Morley Avenue site.

(c) The probable annual cost of filtering at the Island 21,500,000 gallons per day of water which will never be used, but only filtered in order to pass it direct from the leaking water mains to the inleaking sewers.

(d) When the annual costs of a, b and c have been arrived at, then we would like these sums added together and capitalized at, say, 3½ per cent., so that the available capital amount can be arrived at which might be spent in putting the Toronto water supply on a reasonable and efficient basis."

We must not run away with the idea that the Council did nothing after receiving Mr. Rust's report. In 1900 we find a small sum appropriated to test the actual waste in a small portion of the city, extending from Dundas Street on the west to Manning Avenue on the east, and from College Street on the south to the city limits on the north, the number of houses being 2,090; the tubs, 3,008; lawn hydrants, 472; baths, 864; closets, 932. In this section of the city systematic repairs to mains and tap fittings were made. **Before the repairs were made the consumption of water amounted to 234,163 gallons per day. After the repairs were made the consumption amounted to 140,565 gallons per day.** The leaks on mains numbered 58, showing a loss of 26,122 gallons per day, and the leaks to service taps 308, with a loss of 59,304 gallons per day. This loss of 40 per cent. in a sparsely built up section of the city would, of course, have shown a much larger percentage of loss in other parts more thickly populated. Mr. Rust concludes in connection with this test as follows: "The time is not far distant, unless proper means are taken to prevent waste, when the ratepayers will be called upon to provide large sums for improvements to the system."

Now, here comes the point. Although the above facts have been officially made known to the corporation, the facts have been pigeon-holed and embalmed, only to be resurrected by a New York engineer when he finds that his filtration plant is not acceptable to the waste conditions which prevail.

Why, in the name of everything reasonable and municipal, were not the people told at once that the $750,000 voted for water filtration would be of no practical use unless their water supply was measured out to them by a meter? We have to wait until the city is pledged to a filtration scheme, until the work is half completed, until the engineer for the works happens to address a casual meeting of the Canadian Society of Civil Engineers, in order to obtain this important information, quoting the very words of the engineer: "Unless steps are taken by the corporation to lessen the tremendous waste of water, the filters at present being installed will prove inadequate for the purpose of purifying the water."

The above procedure absolutely excels in municipal muddle, and the retention of valuable and available information. However, out of evil good may evolve, and if the conditional predicted failure of the filtration plant will only make the Council wise to the enormous sum annually wasted in pumping 21,500,000 gallons of water per day for the mere fun of simply pumping it and filtering it in order to flush the sewerage system, then we may yet be able to say, "All's well!"

The suggestion to meter the water for domestic purposes in order to curtail the waste is radically bad from a hygienic point of view. The towns quoted by Mr. Rust in Great Britain where the per capita consumption is low are not metered. The British principle is totally against metering domestic supply. For legitimate purposes the people should feel that they have a free and unbounded right to water. Cleanliness should not be made the privilege of those who can afford to bath and wash, and dirtiness the penalty of those who may first have to consider the effect of a morning tub upon the meter index.

There is a huge difference between an unbounded supply of water for legitimate purposes and direct waste caused by faulty mains, bad workmanship, and total lack of proper inspection and supervision.

Where there are good, sound mains and thorough inspection and supervision, an unbounded legitimate supply of water is represented by about 30 gallons per head per day. Any figure above this amount is up to the corporation or those managing the system to explain and make good. The onus is not with the consumer, but with the method of supply.

The October outputs of the Nova Scotia Steel Company were as follows: Steel, 7,148 tons; pig iron, 5,640 tons; coal, 7,126 tons.

* * * *

The statement of the Winnipeg Electric Railway for September shows gross earnings for the month, of $218,088, an increase of 14 per cent., while the net earnings increased 11 per cent. For the nine months of the year the gross totals $1,848,85- an increase of 20 per cent., the net gain being 18 per cent. Earnings are at the rate of 14 per cent. on the common stock.

## SEWAGE DISPOSAL.

### REMOVAL OF PUTRESCIBILITY.

Chapter VII.—Continued.

#### Distributing Appliances.

Revolving sprinklers and travelling distributors have been used more extensively in Great Britain than on this continent for distributing sewage over percolating biological filters.

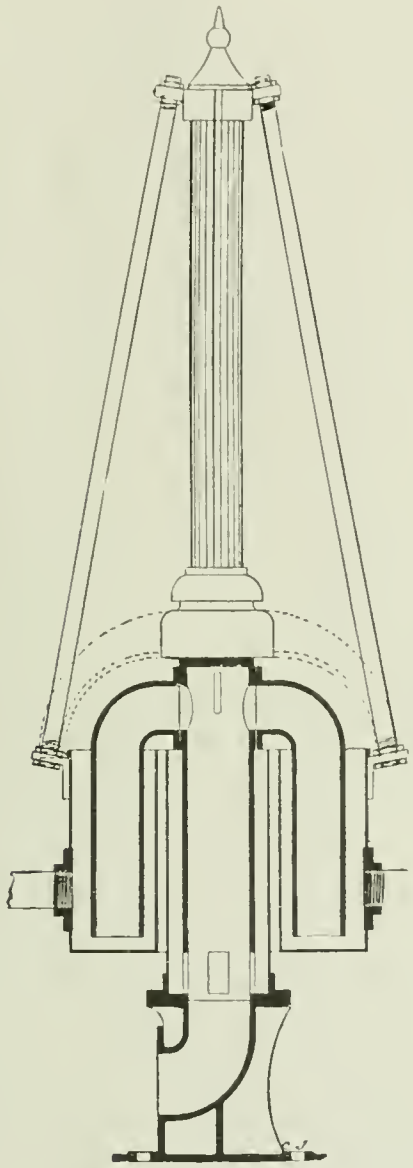
Mr. Clark, chemist to the Massachusetts Board of Health, recently read a paper before the Boston Society of Engineers, following after a visit to Great Britain, his remarks upon revolving sprinklers, are here worth quoting. Mr. Clark states that when he started on his round of visits he was strongly inclined to believe that the use of nozzles (fixed sprays) was the common-sense method, but that he has become convinced that under English conditions revolving or travelling distributors are by far the best, as with these, other things being equal, filters produce better effluents per unit of filter surface, and every square inch of filter can be used. He points out that "by sprinkling nozzles operating under a constant head, as at Birmingham and Salford, as can be seen from observation of these areas, and as has been shown by experiments at Lawrence and elsewhere, only about 50 or 60 per cent. of the filter is really used." That is to say, if 2,000,000 gallons of sewage are applied daily to an acre bed by means of nozzles, a considerable area will operate at the rate of 5,000,000 or 6,000,000 gallons per acre daily, while a portion will only operate at a rate of 500,000 gallons or less. "There is little or no spreading of sewage as it passes through filters of clinker, coke, or broken stone. In other words, if the sewage was as perfectly distributed over the Birmingham filters, as over the Hanley, Heywood, and other filters, the area of these filters might perhaps be reduced 50 per cent., the cost of construction be not more than half as great, and the same purification result be achieved. Even in this country," Mr. Clarke goes on to say, "I believe, perfect distribution, even if the form of distributor necessitates covered

Fixed Sprays.—Hamilton Sewage Disposal Works.

*Prepared specially for the Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

filters for winter work, may in the end be the practical method of construction and operation."

In the case of revolving distributors, the filters are constructed circular in shape. The sewage is generally fed by means of a dosing tank which is supplied with the sewage liquor after the solids have been settled out. There are many forms of distributors on the market, all of which, however, agree in certain general principles. The dosing tank is located about 1 ft. 6 in. above the distributing arms, providing the necessary power for the revolving action. The sewage is generally led by a syphon fixed at the outlet of the



**Circular Distributor.—(Messrs. Jennings, Limited, London, S.E.)**

dosing tank, ensuring intermittency of discharge, and passes to a central drum or cylinder fixed in the centre of the bed. To this drum are fixed four horizontal radiating pipe arms, perforated, to allow the sewage issuing in the form of a spray. The force and head exerted by the sewage, causes the distributing arms to slowly revolve around the filter, the sewage being sprayed evenly over the whole surface. They are made from comparatively small sizes to about 100 feet in diameter; when anything over this diameter is required, electric or other motor power is generally used to promote the revolving action

Owing to the fact that large size revolving distributors are clumsy and heavy, it is more usual to provide filter units of not more than 60 feet in diameter, this size worked with a 1 ft. 6 in. head from the dosing tank gives the best working results.

A filter 60 feet in diameter by 6 feet deep will provide a filter capacity of 628 cubic yards, or a surface area of 1-16th of an acre, and will treat per day 125,000 gallons of sewage at a rate of 200 gallons of sewage to each cubic yard of filtering material, or at a rate of 2,000,000 gallons of sewage per acre.

The dosing tank should be of a capacity equal to a discharge at each syphonage of not more than two gallons per super yard of filter area. In the above case with a 60-foot diameter sprinkler, we have 314 super yards of wetted area which represents 628 gallons for each intermittent discharge. With 125,000 gallons per day, this would allow of about 200 discharges per day, providing 7 minutes for each discharge. On the line of pipe supplying the sewage from the dosing tank to the filter it is usual to insert a regulating valve, so that the rate of supply to the distributor can be fixed for a given period of discharge. In the above case, if the valve be so fixed that the contents of the dosing tank are discharged in 3½ minutes, then 3½ minutes are allowed for rest between each discharge.

At first sight intermittency of supply to a percolating filter may not appear to be of great importance, as air at all times has free access to the body of the filter. In fact, it was the custom at first to work all percolating filters continuously, and they became known as continuous filters in contradistinction to contact beds. It was soon found, however, that greater efficiency attended the automatic dosing tank supply than the continuous supply.

In our issue of October 8th last, it will be noted that the main points to be observed in order to obtain the maximum efficiency in purification from percolating filters were enumerated, two of these points were as follows:—

(d) That the passage of the drops of sewage through the filter be sufficiently slow, to give ample time for the absorption film to extract from each drop of sewage, the organic impurities contained.

(e) That the liquid supplied to the filter never be under pressure, beyond the gravity inherent to each drop, so that there is no flushing of the filter.

The above intermittency of supply at a rate of discharge of 2 gallons per super yard of filter area, appears to provide conditions answering the demands of the above two paragraphs.

Each individual dose of sewage passes through the filter without being pressed forward by the succeeding dose. Revolving distributors supplying sewage to a filter intermittently will provide for twice the amount of sewage which can with equal results be passed through continuously.

Percolating filter beds worked continuously by revolving distributors will treat twice as much sewage per cubic yard of filter than can be treated by contact beds.

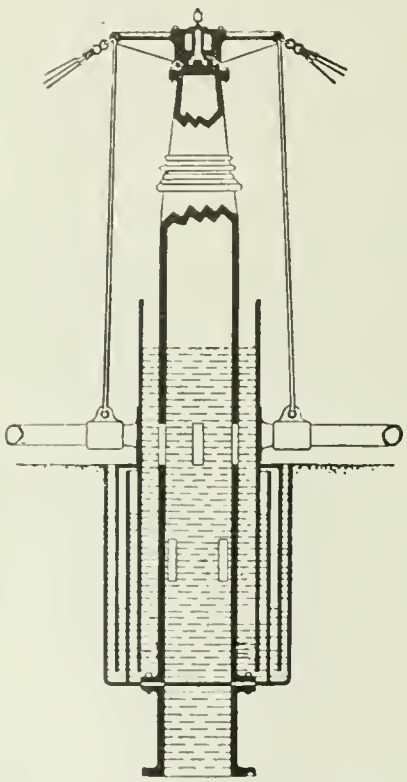
Percolating filter beds worked intermittently at doses not greater than equal to 2 gallons per super yard of filter will treat four times as much sewage per cubic yard of filter than can be treated by contact beds. The revolving perforated arms of the distributors are, as a rule, provided with terminal screw caps, to allow of cleaning. In some cases the distributing arms are open troughs provided with side perforations, in the latter case the power for revolving the apparatus is directed to a turbine placed in the central drum.

Travelling distributors have been designed to meet cases where rectangular filter beds are in use, or for cases where the units are so large that the head obtainable is not sufficient, or again when no head can be utilized and mechanical power must be resorted to. The principal of distribution is, however, much the same, viz., by means of moving perforated arms.

In the case of travelling revolving distributors, it is usual to provide a rail around the circumference in which the arm moves, resting on a wheel, motor driven.

In many cases, however, travelling distributors are worked automatically by the sewage head.. The Candy-Caink distributor is a well-known type. These are in use at Worcester (England), and are 200 feet in diameter.

The "Fiddian" distributor is somewhat remarkable, and is of a different type to the usual form of perforated pipe arm. The sewage is conducted to buckets of an elongated water wheel, which not only revolves on its horizontal axis, but



**The Cresset Distributor.—(Messrs. Adams Hydraulics, Limited, York, England.)**

travels itself on the surface of the filter by means of wheels fixed on or connected to its axle. A head of at least 15 inches is required to operate the apparatus. In this case there are no joints to trouble with, and the sprinkler has no small holes to block up, and it is said to give uniform distribution irrespective of rate of flow.

Perhaps the best known power distributor is that invented by "Scott-Moncrief." It may be worked either by an oil or electric motor on rails as above described surrounding the filter. Good distribution is obtained, but the whole apparatus is cumbersome and weighty, and requires strong walls and foundations to the filter beds, necessitating costly work.

The "Adams Electrically-driven Distributor" is a more simple and less costly apparatus. No rail is required. The motive power is by means of fans electrically driven. A great point in favor of this power distributor lies in an arrangement by which the power is automatically cut off when the velocity of the distributor is sufficient.

For a simple and effective distributor worked without power, the writer from experience can speak well of the "Cresset" distributor, also manufactured by the Adams Company. In the latter case the joint between the standing and moving parts is made by means of an air lock, and there is no mechanical joint. The loss of head is very small. In fact the distributor will work effectually with 9 inches head from the dosing tank. The weight of the distributor is carried on ball bearings running in an oil bath, and the whole design is excellent.

The question will at once be asked,—How about revolving distributors working under the conditions of a Canadian winter? The answer must be emphatic, that if unprotected from the frost, they will freeze up with temperatures at or below zero.

The question, however, of protection is a small one compared with the efficiency in results which are to be obtained. A filter unit of 60 feet diameter can be easily and cheaply protected from frost, and if necessary, completely housed, and the air warmed by a stove. In fact, it is questionable whether sewage purification by nitrification is possible under extreme cold without protection in any case. It is known that nitrification results tend to fall off after certain low temperatures are reached. In parts of eastern Canada where the winters are comparatively mild, some other form of distribution other than by distributors may be resorted to during severe weather. For instance, the revolving distributor can be put out of action, and the sewage led to the filter bed and distributed under the surface by means of weeping pipes. In this case it would not really matter if the filter was covered in a snow drift.

In any case in Canada where it is a question of removing putrescibility from sewage, there is no doubt but that the biological filter system will produce the best results; and further owing to the small area required for such a plant, it is the more suited to our climate because it lends itself to effectual protection from frost.

If we grant the truth of the above proposition, then revolving distributors will prove, as far as present evidence goes to show, the most effective means of obtaining equal distribution of the sewage over the filter surface.

## COMING MEETINGS.

**American Society of Refrigerating Engineers.**—December 6. Annual meeting in New York City. Secretary, Wm. H. Ross, 154 Nassau Street, New York City.

**New Jersey Sanitary Association.**—December 3-4. Annual meeting at Laurel-in-the-Pines, Lakewood, N.J. Secretary, J. A. Exton, 75 Beech Street, Arlington, N.J.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton H. Moore, Butte.

**American Institute of Chemical Engineers.**—December 8-10. Annual meeting at Philadelphia, Pa. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

**American Association for the Advancement of Science.**—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

**American Society of Agricultural Engineers.**—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

**Association of American Portland Cement Manufacturers.**—December 14-15. Annual meeting at New York City. Secretary, Percy H. Wilson, Land Title Building, Philadelphia, Pa.

## EUROPEAN ENGINEERING LABORATORIES.*

Robert W. Angus, B.A.Sc.
Professor of Mechanical Engineering.

During the past summer the writer had the pleasure of visiting Germany, Switzerland, England and Scotland, and made it a point to see the engineering laboratories in Brunswick, Hanover, Berlin, Dresden, Munich and Darmstadt in Germany; in Zurich in Switzerland, and in London, Birmingham, Newcastle, Edinburgh and Glasgow in Great Britain.

In Europe, more especially continental Europe, the engineering laboratory has been brought to a great state of perfection, so that probably the very best in the world are to be found there. To get even a superficial acquaintance with these one would need to spend a very considerable amount of time and energy, and I very much regret that my time was so limited that it was impossible to study the different institutions as I should have wished. It soon became evident that I must not only omit a number of the technical schools altogether, but also that the available time must be devoted to my own special work almost entirely, and it was necessary for me to confine my effort largely to the laboratories in hydraulics and mechanical engineering; i.e., heat engines and boilers and other special mechanical work. This article, therefore, deals almost exclusively with laboratories used in connection with the above special subjects.

With regard to the schools visited, it should be stated that an especial effort was made to visit the most notable in the different countries. It must not be inferred, however, that only the least important were omitted, because after it had been decided that it was essential to visit certain places, geographical location combined with other circumstances determined those that must be omitted, and some places of excellent reputation had, therefore, to be left out.

An account of these laboratories will now be given mainly in the order in which they were visited, and, as Germany was the starting point, the schools in that country will be described first.

### German Technical High Schools.

The Germans are a very thorough and industrious people, who believe in doing well whatever they attempt to do. One is not, therefore, surprised to find that they have been very thorough in the matter of technical education, and that they have established engineering schools of the very highest order.

But the development of these schools is not due alone to the characteristics of the nation, but probably quite as much to the great change in the occupation of the people which has occurred in the last few years. In a report on the German Technical High Schools, made in 1903 by Dr. Rose to the British Government, it is pointed out that in 1871 the population of Germany was 38,000,000, of whom only about 15,000,000 were in the various industries, the remainder being engaged in agricultural pursuits. In 1900 the population had increased to 58,000,000, of whom about 38,000,000 were engaged in the industries, while the number in agricultural pursuits was slightly less than in 1871.

It will be self-evident that the nation which is to have a healthy industrial growth must at the same time properly prepare her people for their opportunities in this regard, and must train her men to develop the industries in the best possible way. The importance of engineering schools in this connection is well known, and Germany has not been slow to realize this, and has established within the last forty years no fewer than ten Technical High Schools for the teaching of engineering and allied sciences. These schools are located at Aachen (Aix) Brunswick, Berlin, Darmstadt, Dresden, Hanover, Karlsruhe, Munich, Stuttgart, and Dantzig, cities pretty well distributed over the empire, many of them also being located in important industrial districts. The number of these schools is being increased from time to time as occasion demands.

It is to be noted that the above list includes only the Technical High Schools and not the great number of universities and schools of various other kinds which are engaged in a somewhat similar line of work. The term "Technical High School" must not be misunderstood in this connection, as it designates an entirely different class of institution from that to which the name is applied in this country. In Germany the name is applied to the real engineering school, the students in these being of similar standing to regular university students and the courses of instruction being somewhat more advanced than engineering courses here.

The amount of money expended on the establishment of these various schools has been very great, and the annual contribution by the State for maintenance is also liberal. It is difficult to get definite information on these points, but so far as could be learned the expenditure for buildings and equipment at Berlin (Charlottenburg) would exceed $2,500,000. but, of course, this is far the largest institution of its kind in Germany. At Hanover the expenditure for similar purposes has been about $500,000, at Brunswick the steam and gas engine laboratory alone cost about $75,000, while all the buildings at Dresden and Darmstadt, both sets of buildings being new, have cost $1,300,000 and $1,500,000, respectively.

The cost of maintenance of these Technical High Schools is also high for various reasons, the most important of which are probably: (1) That the schools are very completely equipped and kept fairly well up-to-date; (2) that there are a great number of instructors, and (3) that the fees are comparatively low. The number of students per instructor (including professors, lecturers and assistants) in very few cases exceeds twelve and in many cases is as low as nine. According to the reports to which I have referred, the annual State support to the various Technical Schools varies from about $178,000 in Dresden, $98,000 in Stuttgart, $92,000 in Hanover, to about $50,000 in Darmstadt, and the total to five of these schools in one year exceeded $470,000. The balance of the money required to maintain these institutions is received from students' fees and other sources, the above figures giving only the support received from the State.

An opportunity offered itself to learn something relative to this matter about Dresden, where it was found that the annual grant for apparatus and supplies for the steam, gas and hydraulic laboratories alone was $3,000.

It may be interesting to state that for the year 1907-8 the Faculty of Applied Science of the University of Toronto cost the State about $66,000 (allowance being made for fees received), and the total invested in buildings and equipment in engineering would not exceed $700,000.

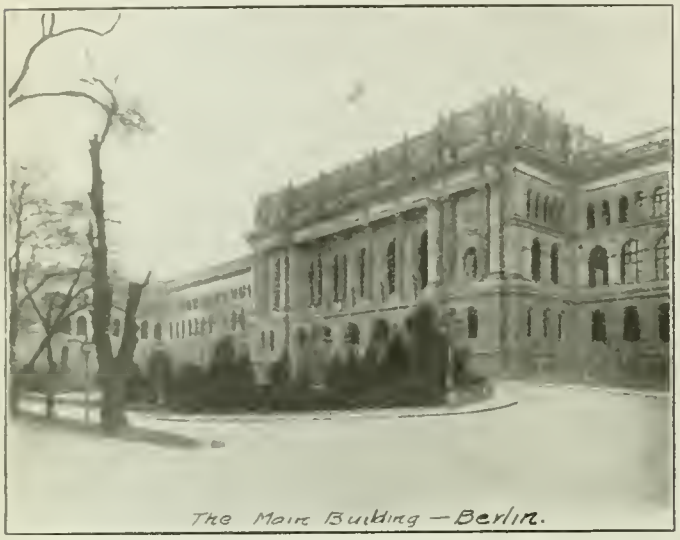
The German people have not been slow to take advantage of the facilities offered along the lines of engineering education, for the total number of students in the nine older schools would considerably exceed 16,000. In Berlin alone there were nearly 5,000 students in 1901-2, in Munich in

*Abridged from an address delivered before the Engineers' Club, Toronto, Ont.

1905-6 about 2,800, while the present attendance at Darmstadt is nearly 2,000, at Brunswick about 500 and at Hanover 1,500.

These statistics are of some interest in showing how technical education has taken hold in Germany, and as I went from place to place and saw many new buildings and new additions to old ones I was fully impressed with the fact that the people are alive to their opportunities in that line.

That the courses given in these institutions are varied and thorough is at once evident on glancing at any of the




**The Main Building—Berlin Technical High School.**

"Programmes" issued by them. I might give one illustration, that of the Munich Technical High School, as the calendar for 1906-7 is at hand. The courses there are: (1) Civil engineering, in which there are three divisions—(a) civil engineering; (b) agricultural civil engineering; (c) surveying; (2) architecture; (3) mechanical engineering, which is sub-divided into (a) mechanical engineering; (b) electrical engineering; (4) chemistry; (5) agriculture. All these courses extend over four years, with the exception of surveying and agriculture, both of which are three-year courses.

Space will not be taken to quote the list of subjects in each year, but these would indicate more advanced mathematics than is given in this country, and, indeed, an examination of the entrance requirements for fully-qualified students shows that the latter are much more advanced when they enter than the matriculants here. A fairly large proportion of these entering have a considerable knowledge of both analytical and descriptive geometry, and of the calculus, and are well advanced in the general subjects.

The absence of shops and shopwork is very noticeable in the German Technical High Schools, as these shops are very common both in Great Britain and America, scarcely any institution in the latter two countries in which mechanical engineering is taught being without them. As there is considerable discussion on this question of university shops continually being heard, careful attention was paid to this point, but I was unable to find a single school in Germany with these shops, the opinion apparently being that the proper place to learn shop practice is in the shops of manufacturers, and some experience in this class of work is practically always demanded before graduating, in many cases a year of work in a manufacturing plant being required.

The money which would otherwise be invested in the shops is thus devoted to laboratory equipment.

### Berlin.

In both Hanover and Brunswick the opinion was freely expressed that in order to see the best Technical School one must go to Berlin, and as this institution is well known to us in America my anxiety to get there increased daily, and it was with considerable expectancy that I reached this great German city.

Berlin has a population of about 3,000,000 people, and is probably the greatest commercial and manufacturing city in Continental Europe. The manufactures include large numbers of locomotives, engines, dynamos, etc., and here one finds enormous shops, such as those of the Allgemeine Electricitats Gesellschaft, with a working capital of $25,000,000 and 13,000 employees; the Berlin Maschinenbau Aktien Gesellschaft, a very large concern, having special residences erected for its men; Siemens and Halske; the Borsig works, employing 6,000 men and turning out 450 locomotives yearly in addition to many engines, pumps, etc., and many other very large shops. This city is also the capital of Prussia, is the residence of the Kaiser, and the seat of the Imperial Government.

Here, then, in this great city in the midst of so much business and progress one naturally expects to find a first-class engineering school, and one does not expect too much, for the Royal Prussian Technical High School is in many respects by far the greatest in Europe, and doubtless also in the whole world. Passing out through the delightful Tiergarten, one sees on crossing a small stream the massive "Hauptgebaude" or main building, a magnificent structure nearly 750 feet long and about 290 feet wide, with a floor area exceeding 330,000 square feet.

**Interior Main Building—Berlin.**

To appreciate fully the grandeur of this building one must visit it, for it is so customary to see engineering schools plain and with very little adornment that one seems to be in a strange atmosphere in this grand place. The building was erected in 1878-84, and is richly decorated with busts and sculptures of such noted men as Gauss, Eytelwein, Schinkel, Redtenbacher and many others, amongst whom it was a pleasure to see Watt and Stephenson. In

front of the building are monuments to Alfred Krupp and Werner Siemens. Some illustrations are given of the general appearance of this building.

This Technical High School had its beginning in 1799 as a Royal Building Academy, which was combined in 1870 with a Trade Academy established in 1821. Since 1879 it has borne its present name. On the celebration of its one hundredth anniversary in October, 1899, the Kaiser granted the school the right to bestow the degree of Doctor of Engineering, a degree first conferred upon Prince Henry of Prussia (honoris causa).

There are about fifty-five fully qualified professors, besides many assistants, private lecturers, etc., making a total teaching staff of nearly two hundred. There are nearly 5,000 students in attendance, of which number about 80 per cent. are fully qualified. Nearly one-half of the students take the mechanical and electrical course, a fact not surprising in view of the great amount of manufacturing done in Germany.

The Berlin Technical High School, like other Prussian schools of the same class, is under the control of a Rector and Senate. The Rector is elected annually by the votes of the professors, but his election must be approved by the King of Prussia.

Returning now to the buildings, it will be seen from the plan of the grounds that almost every laboratory has a separate building of its own, the main building being used for the collection of models, lecture rooms, museums, professors' rooms, draughting and other rooms of like nature, some laboratories and the offices of the institution. There are thus ten buildings, viz.: 1, The main building, already mentioned; 2, a building for mechanical engineering; 3, a chemical building; 4, a building for experiments on heating and ventilation; 5, a building for testing materials and gas engines; 6, an electrical laboratory building; 7, a building for steam engines; 8, a boiler-house; 9, a chemical museum; 10, an hydraulic building. These buildings also contain the laboratories for belt-testing for gas and oil engine and automobile testing, and for the testing of the power required to drive machine tools.

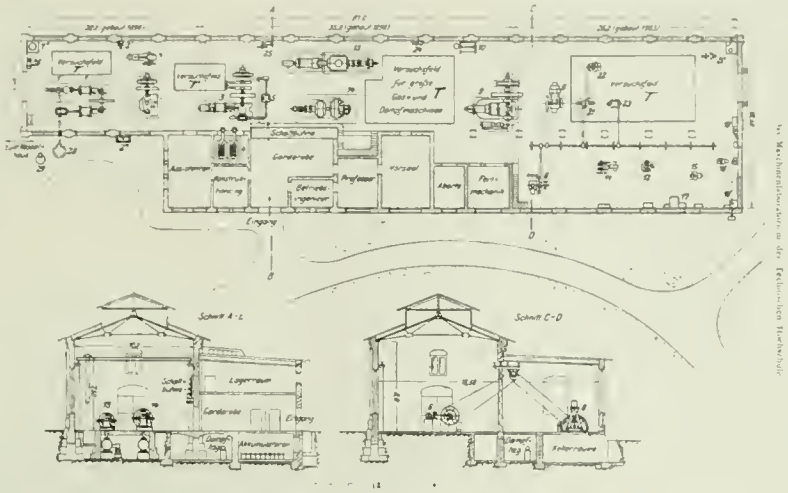
In such an institution it is evidently impossible in limited time to look carefully into all the laboratories, so that it was possible only to glance through many of them in order to leave proper time for the machine, gas engine, belt-testing and hydraulic laboratories, which will now be described in some detail.

(a) The Engine Laboratory.—The building containing this laboratory, which was erected in the years 1896, 1898 and 1903 (see figure)., is 365 feet long and of width varying from 33 feet to 60 feet, the clear height of the main portion being 26 feet. It is well lighted throughout by very large side windows, as well as by others in the roof, and the whole main part is served by a travelling crane of five tons' capacity. Some of the engines are used for light and power, but as there are so many of them in the building no difficulty seems to be experienced in getting any machine desired for experiment.

The laboratory contains a horizontal cross-compound engine of 60 horse-power, directly connected to a pump and all parts specially arranged for testing; a 220 horse-power quadruple marine engine, complete, with condenser; a 150 horse-power triple expansion engine for superheated steam; a 300 k.w. Brown-Boveri Parsons turbine; a 200 k.w. turbine by the Allgemeine Electricitats Gesellschaft, Berlin; a 40 horse-power Woolf locomotive type engine and boiler; several types of air compressors of good size; a 150 horse-power Deutz suction gas engine; a number of gas and gasoline engines, and a Borsig refrigerating machine. In connection with the machines described there are necessary condensers and pumps, gas meters and all conveniences for testing, and nearly every machine drives a dynamo, which is used to produce the load for experimental work. Friction brakes are not considered as reliable as electrical loads, so that the former are not used to any extent.

This laboratory also contains a number of dynamometers of various styles, apparatus for testing nozzles and orifices, and several fairly large testing floors. All pipes are placed under the floor, either in trenches or in the basement, which extends under part of the laboratory and provides room for some of the condensers and pumps.

This laboratory is well adapted to research work on account of the large size of the machines, and some very valuable work has been done, results of which are published in German periodicals



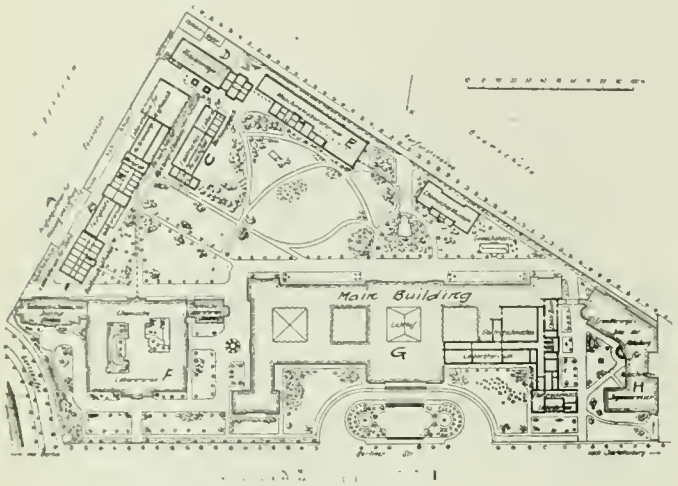
**The Engine Laboratory.**

1, 1[1] horizontal engine and pump; 2, quadruple expansion engine, 220 horse-power; 3, triple expansion engine, 150 horse-power; 4, superheater; 6, Wolf locomotive type engine; 7, air compressor; 9, suction gas engine, 150 horse-power, 13—300 k.w. Parsons turbine, 15—200 k.w. turbine. Other numbers refer to small machines. T are test and research floors. The dimensions are in metres.

It should be stated that the descriptions of the apparatus are not complete, and in such an article as this it is possible merely to mention the more important machines.

The laboratory is under the direction of the well-known Prof. Josse.

(b) The Gas Engine Laboratory.—This laboratory, which is in charge of Prof. Riedler, is designed especially for testing gas engines and automobiles, although, as previously stated, there are a number of gas engines in the engine laboratory just described. The space available for this work is over 170 feet long, and varies in width from over 40 feet to about 70 feet, the height being about 25 feet, and all the light being obtained from the sides. The whole of the building is served by a ten-ton travelling crane.




**Plan of Berlin Technical High School Grounds.**

Starting from the lower left-hand corner and going up the side of the triangle the first building, A, is the laboratory for heating and ventilation research; the next, B, is for strength of materials and gas engine and automobile testing; C, the electrical laboratory; D, the boiler-house; E, the engine laboratory; F, the chemical building; G, the main building; H, the building for mechanical engineering.

The laboratory contains a 200 horse-power suction gas engine, with dynamo, constructed by the Vereintige Maschinenfabrik, Augsburg. This engine, which is four-cycle and double-acting, has the latest type of valve gear, and is well adapted to testing. The gas for this engine is made by suction gas producers, of which there are two of 200 horse-power each, located in a separate building, the gas being led over to the laboratory in pipes.

In addition to the above there is a 40 horse-power Korting engine, a 25 horse-power Korting oil engine, a 20 horse-power Diesel engine, several other engines, special apparatus for doing research work on explosive mixtures, numerous gas meters, etc. The engines are all equipped with dynamos, which are used to produce the load.

A very interesting feature of this laboratory is the automobile testing plant, designed for testing the horse-power and tractive force of automobiles of all sizes and powers up to 200 horse-power. The power of the engine is determined by placing the automobile on a dynamometer driven by the back wheels of the latter, which dynamometer may be adjusted to suit any size of machine. Power is absorbed partly by means of dynamos and partly by Prony brakes, the former being very easily adjusted to give any load desired with great precision. The tractive force is also measured by a special device, which cannot be explained here for lack of space.

That this automobile testing plant is in great demand was evidenced by the fact that there were five or six machines waiting to be tested when the laboratory was visited.

There are also testing floors available for other purposes, space being left below these so that access to the lower side of the floor may be easily obtained.

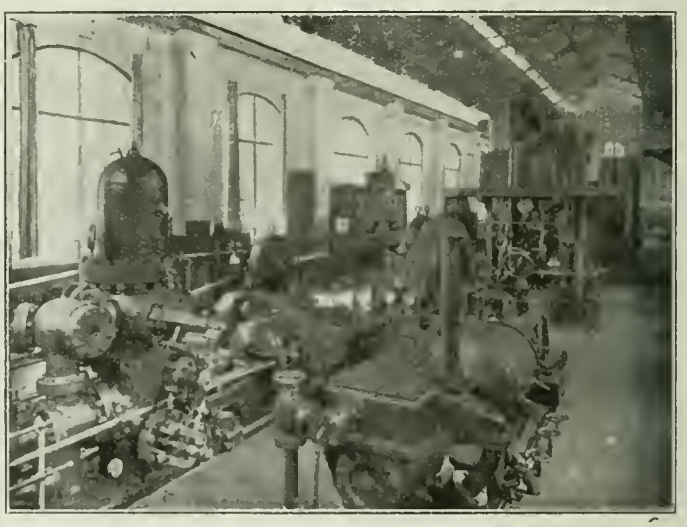
(c) Laboratory for Testing Belts and Machine Elements.—This laboratory is about 23 feet wide and 90 feet long, and contains various machines for testing the friction of journals, the holding power of friction clutches, and for similar work connected with the elements of machines. There is also a belt-testing machine capable of testing pulleys eight feet in diameter, driving a belt as wide as 16 inches. The machine is driven by two 100 horse-power motors, which may run at any speed from 200 to 600 r.p.m. Rope pulleys, six feet in diameter, with four grooves, may also be tested on this machine.

The power applied to the belts is measured at the motor, and the power delivered, as well as other data relative to the working of the belt, obtained by suitable means at the driven end.

On this machine, in addition to the work on leather belts and various kinds of ropes, very valuable experiments on the steel driving bands now in use in Germany have been made, and with a machine of this size reliable information may be obtained on full-sized specimens instead of on the small models which must be used in most schools.

(d) Laboratory for Heating and Ventilation.—I regret that I have been unable to get any material description of this laboratory. The apparatus is very elaborate and complete, and a description is soon to be published. This laboratory is about 500 feet long and 20 feet wide, so that it is quite extensive.

(e) Hydraulic Laboratory.—This laboratory, which is illustrated here, is situated some distance from the other buildings, in order to bring it beside a natural stream of water. The stream in question is the Landwehr Canal, which is used by barges in the city of Berlin, and which joins the River Spree about a mile distant.



**The Engine Laboratory—Berlin.**

Adjacent to the hydraulic laboratory for the Technical High School is the large channel installed by the Government for making tests on ships' models, etc.

In almost all cases hydraulic laboratories situated on natural streams are smaller than those not so situated, because in the latter case a very considerable amount of room is occupied by the large pumping machinery required for the supply of water for turbines of the reaction type, and also because experimental artificial channels must be pro-

vided in the buildings to take the place of the natural channel outside.

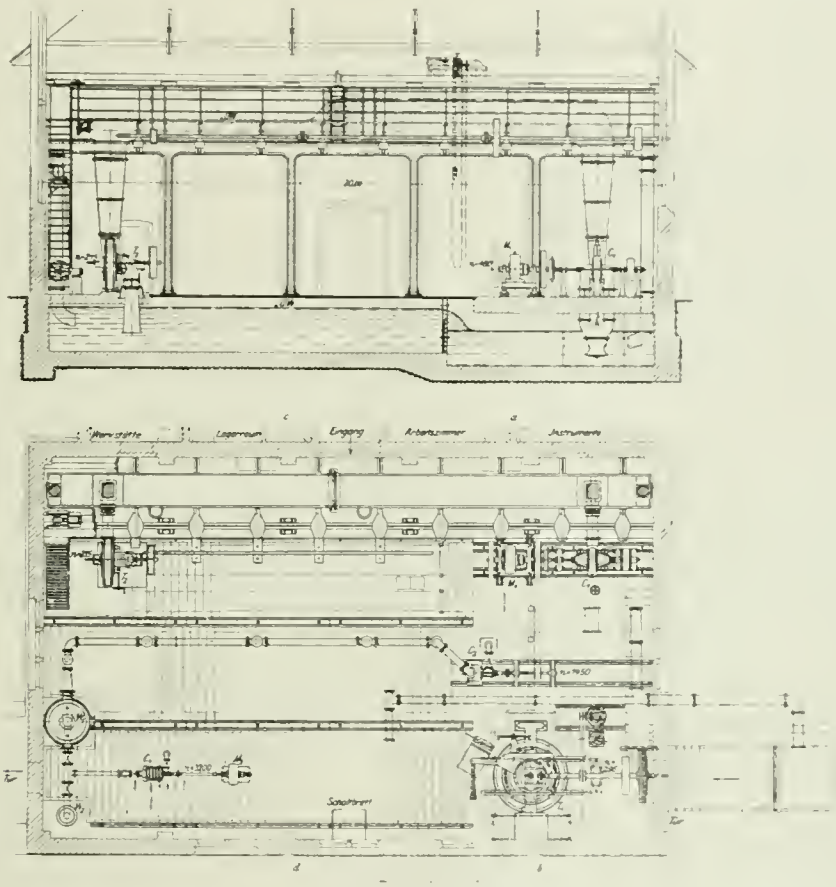
The power obtained from the stream of water is used laboratory of the Technical High School at Berlin, which occupies a building over 60 feet long and about 58 feet wide, but also includes a channel outside about 180 feet long. It is in charge of Prof. Ernst Reichel.

The power obtained from the strteam of water is used in driving a turbine with vertical axis made by J. M. Voith, of Heidenheim, for experimental purposes. The available fall is only about five feet, but there is a flow of about 85 cubic feet per second, so that the turbine is of fairly large power. It runs at a speed of 74 revolutions per minute, and is equipped with a good turbine governor and a brake for measuring the power, but the wheel may also be used for driving the pumps, etc., in the laboratory if desired. Numerous experiments are made on the wheel, and facilities are also provided for the testing of wheels of other makes. The discharge water is measured by a method fairly common in Germany, but apparently not used in this country so far as I am aware. On account of the low head available it was deemed inadvisable to use a weir, which would mean the loss of a part of the available head, in this case seriously reducing the latter.

The cross section of the tailrace is rectangular and of uniform section, and a screen of light material impervious to water is made, which is placed in the stream in a vertical position and normal to the direction of flow. This screen is supported on light, frictionless rollers, and as it nearly fills the channel the velocity of the screen gives the mean velocity in the cross-section if the screen is properly designed and supported.

This method of measuring water appears to be accurate, and is very convenient, although it cannot be used in any irregular channel nor in a channel of shallow section. In the latter case the screen can scarcely be made to show the average velocity in the stream, because it must in all cases be kept some distance above the bottom of the latter, and hence it is not properly affected by the bottom velocity, the screen thus moving at a faster rate than it should.

On account of the small natural head available a second turbine has been installed, to which the water is supplied by a centrifugal pump, and in connection with this there is a long steel channel about 3 feet wide, 6 feet high, and about 55 feet long, supported near the roof by means of steel columns.



**Hydraulic Laboratory.**

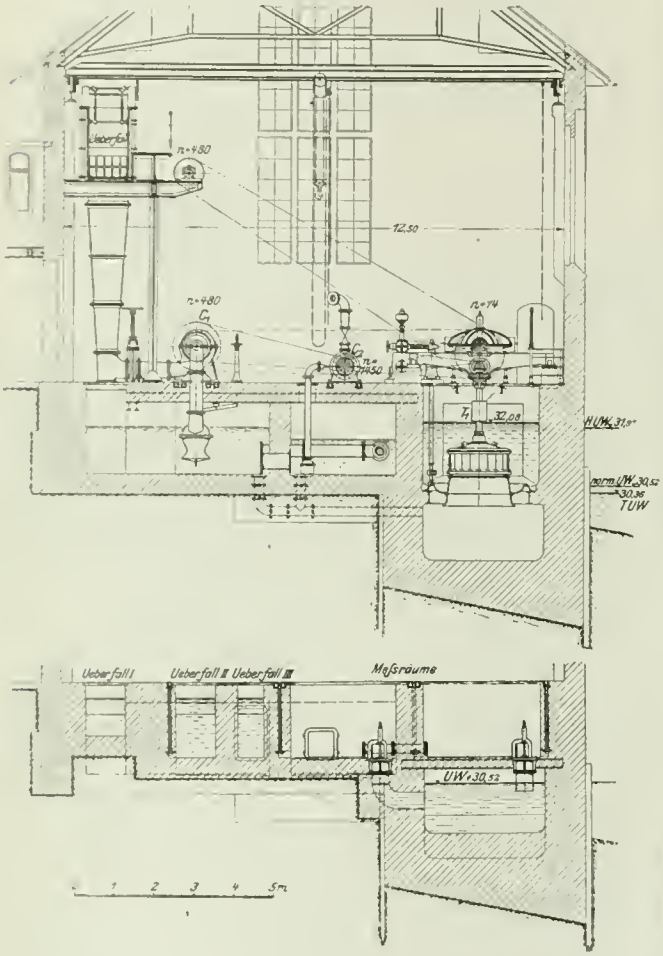
$T_1$ 40 horse-power Voith turbine, $C_1$ Gehauer pump, $M_1$ electric motor, $T_2$ Voith turbine for 20-foot head, $C_2$ Weise and Monski pump, $C_3$ and $M_3$ Jaeger six-stage pump and motor. Measuring channels below the floor are shown. Dimensions are in meters.

Water is supplied to this channel by a centrifugal pump built by Gebauer, and having a capacity of nearly 9 cubic feet per second against about 24 feet head. The water flows down the channel, and after passing over a weir, where it is measured, is delivered to a Voith spiral turbine of the full capacity of the pump.

The laboratory further contains a Weise and Monski four-stage pump for 33 feet head and about 0.7 cubic feet per second; a six-stage Jaeger pump for 650 feet head; various motors for driving the pumps; three fairly large measuring canals under the floor; a large vessel for pressure work, and various other devices for measuring jets and determining the resistance of pipes, etc.

Every facility is offered here for reliable research work, and the laboratory is rather crowded. Commercial turbines are also tested here, and up to the present time fifteen have been tried; in such cases the working head, the speed and the discharge are all automatically recorded simultaneously on one instrument.

The apparatus for this laboratory cost about $23,000, exclusive of the channels, etc., made in concrete under the floor.




Hydraulic Laboratory.

This brief description shows that this great school is well worthy of careful study, and indicates that the laboratories present exceptional opportunities for research work. Good advantage has been taken of the facilities offered, and the institution well deserves the prominent position it now occupies amongst the leading Technical Schools of the world.

## BONDING OF NEW AND OLD CONCRETE

The statement is advanced that bonding new and old concrete can be accomplished in the following manner: Clean the surface of the old concrete with clear water and a stiff broom. Apply a mixture of one part of hydrochloric acid and three parts of water with a brush, making several applications one after the other. Then scrub the surface with clean water and a stiff brush until all the acid is washed away and the surface is perfectly clean and free from loose particles. While it is still wet apply the fresh concrete, and keep the new concrete damp for at least a week, being careful not to allow it to become dry at any time.

## PROBLEMS IN APPLIED STATICS.

**T. R. Loudon, B.A.Sc.**

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

For the forces acting at the point BPLG (Statical Diagram, Fig. 75):—

$$\Sigma Y = Y_{BP} + Y_{PL} + Y_{LG} + Y_{GB} = 0.$$

$$0 - \frac{8{,}000}{\sqrt{3}} \cdot \frac{\sqrt{3}}{2} + LG \cdot \frac{\sqrt{3}}{2} + 0 = 0.$$

$$LG = \frac{8{,}000}{\sqrt{3}}.$$

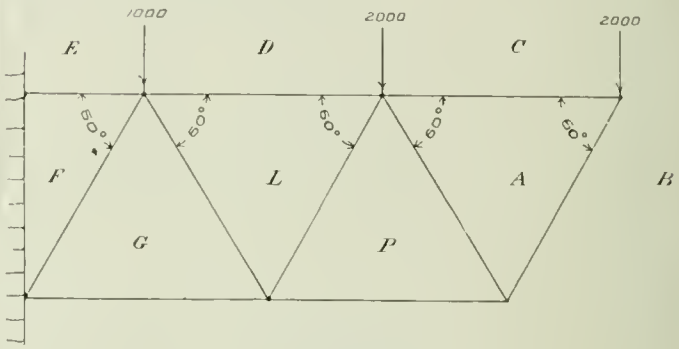



Fig. 67.

From this positive result it is seen that $Y_{LG}$ is positive. LG is, therefore, a tensile force; i.e., the membe.

LG is in tension $\frac{8{,}000}{\sqrt{3}}$ pounds.

For the same point:—

$$\Sigma X = X_{BP} + X_{PL} + X_{LG} + X_{GB} = 0.$$

$$-\frac{4{,}000}{\sqrt{3}} - \frac{8{,}000}{\sqrt{3}} \cdot \frac{1}{2} - \frac{8{,}000}{\sqrt{3}} \cdot \frac{1}{2} + GB = 0.$$

$$GB = \frac{12{,}000}{\sqrt{3}}.$$

The $X_{GB}$ is evidently positive. GB is seen to be a compressive force. The member GB is, therefore, in compression $\frac{12{,}000}{\sqrt{3}}$ pounds.

Considering the point GLDEF (Statical Diagram, Fig. 77):—

$$\Sigma Y = Y_{GL} + Y_{LD} + Y_{DE} + Y_{EF} + Y_{FG} = 0.$$

$$-\frac{8{,}000}{\sqrt{3}} \cdot \frac{\sqrt{3}}{2} + 0 - 1{,}000 + 0 + FG \cdot \frac{\sqrt{3}}{2} = 0.$$

$$FG = \frac{10{,}000}{\sqrt{3}}.$$

The $Y_{FG}$ being positive (from the positive result), FG must be a compressive force; i.e., the member FG is in compression $\frac{10{,}000}{\sqrt{3}}$ pounds.

For the same point:—

$$\Sigma X = X_{GL} + X_{LD} + X_{DE} + X_{EF} + X_{FG} = 0.$$

$$\frac{8{,}000}{\sqrt{3}} \cdot \frac{1}{2} + \frac{8{,}000}{\sqrt{3}} + 0 + EF + \frac{10{,}000}{\sqrt{3}} \cdot \frac{1}{2} = 0.$$

$$EF = -\frac{17{,}000}{\sqrt{3}}.$$

The negative result shows that $X_{EF}$ is negative. In accordance with this, EF is a tensile force. The member EF is, therefore, in tension $\frac{17{,}000}{\sqrt{3}}$ pounds.

It is seen that these results check those found by graphical means. It must be recognized, however, that the so-called graphical solutions taken up so far in these pages have not been entirely graphical. Instead of constructing the diagrams and finding the magnitudes of the forces by scaling the lengths of the lines composing the Vector Polygon, trigonometrical means have been used to get at these quantities. The solutions have, therefore, been partly analytical. The point of the discussion is that had purely graphical means been employed there would have been found an error in the magnitudes of the forces as compared to the values obtained analytically, but this error is so small that in practice it does not amount to anything. Analytical results are, of course, perfectly accurate.

**If a set of forces is in equilibrium, the algebraic sum of the moments of the forces about any point is equal to zero.**

Fig. 80 represents diagrammatically the method of arranging a system of levers in a weighing scale. Of

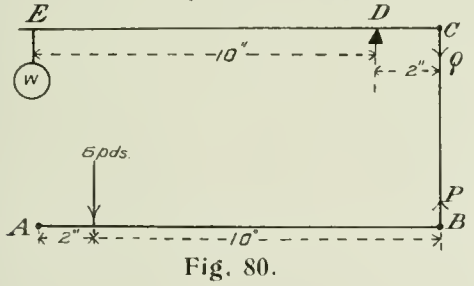



Fig. 80.

course, there are certain constructional details which cannot be represented in such a figure, but nevertheless this problem illustrates the principle involved in all weighing scales and machines for testing the strength of materials.

AB and EC are two levers, the former being hinged at A and the latter resting on a knife edge D. The vertical rod BC is connected to these two levers at B and C by pin joints to allow of free motion of the system.

**A force of six pounds is exerted on the lever AB at a distance of two inches from the hinge A. What is the magnitude of the weight W placed on the upper lever at E such that the whole system is in equilibrium?**

Consider the lever AB. It is acted upon by three forces; the vertical force of six pounds, an unknown vertical force P at B, and the reaction at the hinge A. These forces are in equilibrium; therefore, if moments be taken about any point, $\Sigma M = 0$.

Take moments about the point A.

$\Sigma M = (\text{reaction at A} \times \text{zero}) + 6 \times 2 + P \times 12 = 0 \ldots\ldots\ldots (1.)$

Since we do not know whether P acts upward or downward, the moment of P is assumed positive.

$$P \times 12 = -12.$$

$$P = -1.$$

This negative result shows that the moment of P about A is negative; i.e., P acts upward at B as indicated by the arrowhead, and is of magnitude one pound.

The rod BC exerts a tensile force at B. It must, therefore, exert an equal and opposite tensile force Q at its other extremity C; i.e., at C there is a vertical force of one pound acting downward as indicated by the arrowhead.

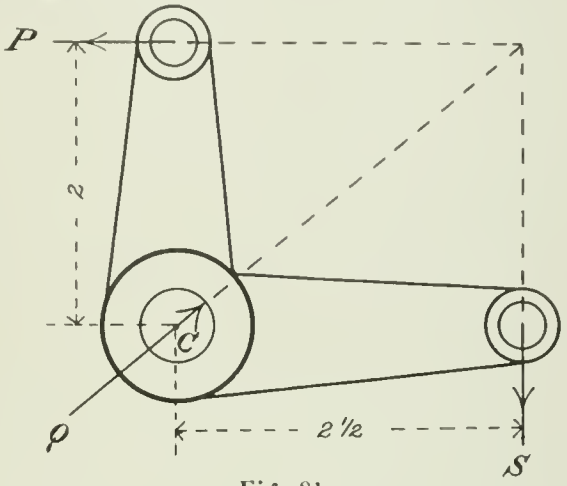



Fig. 81.

Consider the lever EC. It is acted upon by three forces in equilibrium, viz., the force W acting at E, the reaction of the knife edge at D, and the known vertical force acting at C. For this set of forces, $\Sigma M$ about any point equals zero.

Take moments about D:—

$\Sigma M = Q \times 2 + (\text{reaction at D} \times \text{zero}) + W \times 10 = 0 \ldots\ldots (2.)$

Putting in the known value of $Q = 1$, we get:—

$$W \times 10 = -2.$$

$$W = -1.5.$$

That is, W is a weight of 1.5 pound, and acts in such a manner as to give a negative moment about D. W, therefore, acts downward.

The reader may question why the moments of P and W in equations (1) and (2) were written positive when his experience would most likely say that both these quantities should be negative in compliance with the convention of positive and negative moments. It must be kept in mind, however, that although experience says that P must act upward and W downward, thereby giving negative moments, it is dangerous practice to assume these self-evident facts in the first place. It is generally safer to assume these forces totally unknown and then by the reasoning of the problem deduce how they act. The moments of unknown forces are, of course, assumed positive, just as an unknown quantity in an ordinary algebraic equation is assumed positive.

Fig. 81 represents an ordinary bell crank.

**If a force P of 100 pounds be exerted at the joint of the upper arm as indicated, what force S must be exerted at the joint of the other arm in order to preserve equilibrium.**

## GOVERNMENT BY COMMISSION—THE ONTARIO RAILWAY AND MUNICIPAL BOARD.

J. E. Parsons, B.A.*

The great arbiter as between citizen and citizen has for ages back been the law court, and in the days when the private citizen disputed with his neighbour the law court was a sufficient arbiter and an efficient means of redress for the majority of grievances. But conditions have changed and the court which would have been efficient then is efficient now in theory, but often only in theory. The court that was able to enforce British fair play between citizens of equal standing and importance in the community often lacks the foresight or jurisdiction requisite in dealing with the huge corporations of the present day, and the difficulty becomes still greater when the individual citizen who can invoke the law, but the law only, stands opposed to the combine or corporation which can invoke the law and wield unlimited influence and financial strength at the same time. Such are the conditions which have called into existence the numerous Commissions and Boards of Arbitration of the present day and, while these may not be perfect, they constitute an honest attempt on the part of Government to keep pace with changing social conditions. In some respects we venture to assert the Commission marks a great advance from the former state of affairs.

The feature most likely to impress the public is the increase in speed and promptness. The judge whose reputation rests upon his interpretation of the law must needs be careful, for the court of law that fails in this regard fails in the all important purpose for which it was set up and which alone can justify the court's existence. But the Commission rests upon a different basis; correct interpretation of the law is a desirable but secondary consideration with it, and the mass of decisions and rules of court are largely thrown aside. The Commission is not a court to interpret laws but a method of government; it is instituted for the purpose of disposing of certain work, and when that work is handed over to it, it should be able to despatch business with equal efficiency and greater despatch than formerly was attained in the courts. If it expedites the despatch of business in its own particular line it succeeds in justifying its existence even if it should occasionally err upon a question of law.

Then, too, it simplifies procedure. All things are simple after we have learned to do them, but even the experienced solicitor is often at a loss what process to invoke and what remedy to follow in the tribunals open before him. In the Commission all work in a particular line is classed together. It follows to some extent the principle of division of labour and the responsibility for a particular class of work is centralized at a point, i.e., the Board of Commissioners. A great step forward is attained when the average citizen can appear before a tribunal and state his case in common terms without fear of being thwarted by technicalities, which are to him alike meaningless and vexatious; often ready to entrap him and always present to burden him with fear.

But the greatest improvement of all in our opinion seems to be the utilization of expert knowledge. The Commission makes it possible to employ expert business men for work which none but experts in that line can be fully qualified to discharge. Our legislators with all due respect are amateurs. They are men for the most part without any particular training or education in governmental lines, while from them is expected proper fulfilment of the most important functions in the country. That democratic institutions are a blessing no Britisher will deny, but surely there should be some means of procuring for parliament skilled men able and willing to see and appreciate the manner in which laws must be enforced. We venture to assert that under existing conditions the average member of the legislature knows little and cares little as to the enforcement of the laws he has made. He can readily avoid responsibility by hiding behind the crowd. The like remark applies equally if not more strongly to the men who sent him there. The people muster (sometimes) to a public duty, and casting aside party prejudice insist upon some measure which they see is for the public good; but once the desired Act is placed upon the Statute books they drop the work, and returning to their daily rounds expect enforcement from some source they know not where.

Under the old regime the expert lawyers and engineers are outside of the courts and mostly outside of parliament; they formed a reserve to be used in attacking the legislation enacted but were not available for constructive work.

The Ontario Railway and Municipal Board consists of three members appointed by the Lieutenant-Governor, and replaces the former Railway Committee. The Railway Committee was necessarily chosen from the Legislature and, with the choice restricted, the abilities of the members and the possibilities of the Department suffered commensurately. The Railway Board is outside the political arena; further, with the world to choose from, we have the chance for larger men and have secured them.

In the Dominion Board we have secured an aggressive and practical judge as chairman. He is an expert who appreciates the responsibility that comes with power and does not shirk it. His legal experience is a great gain, especially when joined as it is with a colleague who is in truth a railway expert. The Ontario Board benefits similarly. The provision that no member shall hold stocks or bonds of, nor be otherwise personally interested in any particular railway company is a safeguard of impartiality. Certainly a board of experts such as these, bound to devote their entire time to that especial work, should be more efficient than the erstwhile committee of amateur politicians. Provision is made that additional experts paid by the government may be asked for if required—they are not paid by the party calling them and should therefore be free from bias.

The board has full power to enforce the performance of duties by companies and municipalities, in Ontario, its authority being both mandatory and prohibitory; it has full rights, powers and privileges such as are vested in the High Court, thus saving many years delays in appealing to different tribunals; it may take the initiative of its own accord, whereas the courts acted only when appealed to and has certain powers conferred upon it exclusively by statute. The power to informally make, amend or annul its own orders is surely safely conferred upon a tribunal worthy of public confidence and gives great elasticity to the existing powers, and dispenses with otherwise unavoidable "red-tape" to the great assurance of laymen.

On our American railways possibly the greatest question of all is the safeguarding of life; the board may make regulations as to the means of passing from car to car, and of coupling cars, and for the protection and shelter of employees when on duty; the installation of guards and fenders is provided for as well as signals and other devices such as are satisfactory to the board. The jurisdiction as to ordering of protection for crossings and enforcing action by municipalities is much more simple and adaptable than any process of court, especially when accompanied as it is with full power to enter upon the premises of the company or municipality to

* Barrister at Law, 18 Toronto Street, Toronto.

enforce its rules by force or otherwise; the right of entry need not be often exercised but it is a valuable remedy in case of non-compliance with orders made.

The multiplicity of appeals is done away with. Appeals can be made to the Court of Appeal for Ontario but not as a matter of right; permission must be first obtained from the said Court of Appeal. Appeals to the Privy Council are confined to cases where the sum involved amounts to $4,000 and some other instances where public rights are in question.

## SOCIETY NOTES.

**Engineers' Club of Toronto**

At the meeting of the Engineers' Club of Toronto, held on Thursday evening, November 18th, an interesting paper, dealing at some length with the practical side of producer gas plants, was read by Mr. Michael Chapman, A.M.I.E.E., of Toronto. Through the courtesy of Mr. Chapman, we hope to print his paper in full in our next issue.

**Toronto University Engineering Society**

At a meeting of the above society, to be held on Wednesday afternoon, December 1st, at 4 o'clock, Mr. T. Aird Murray, consulting engineer, Toronto, will deliver an address on "Modern Aspects of the Sewage Disposal Question."

**Toronto University Engineering Society**

At a meeting of the Civil and Architectural Section of the Engineering Society, University of Toronto, held on Wednesday afternoon, Nov. 17th, Mr. A. C. D. Blanchard, A. M. Can. Soc. of C. E., assistant city engineer of Toronto, delivered an interesting address on the "Design and Construction of an Intercepting Sewer," accompanied by views, showing progress work on the high level intercepting sewer in Toronto. After some reference to the topography of the city, Mr. Blanchard dealt with sewer design in general, outlining the scheme which has been adopted in Toronto. Speaking of the design of the interceptor, particular attention was paid to the calculations involved in estimating the probable population of Toronto and the probable amount of sewage that would be collected in 1930, that date being set as a reasonable time limit for present provisions. The difficulties encountered in connection with surveys were pointed out, and after a few words relating to specifications, the methods employed in the construction of the intercepting sewer at Toronto were described at some length.

Over two hundred were present, among them being Dean Galbraith of the Faculty of Applied Science, Toronto University, and Dr. Oldwright, who took part in the discussion. Mr. J. C. Murton, presided.

**Toronto Section, American Institute of Electrical Engineers**

The November meeting of the Toronto section of the American Institute of Electrical Engineers was held on Friday evening, the 19th inst., in the rooms of the Engineers' Club. Papers on the "Various Aspects of the Tungsten Lamp" and "The Tungsten Lamp for Street Lighting," were presented by Mr. G. S. Merrill and Mr. J. S. Hoit, both of the National Electric Lamp Association, Cleveland, Ohio.

Mr. H. W. Price, B.A.Sc., presided, and among those taking part in the discussion were Mr. K. L. Aitken, city electrical engineer, Mr. W. H. Eisenbeis of the Canadian Westinghouse Co., Mr. E. Richards, B.A.Sc., and Mr. Sweeny.

Prior to the meeting, an informal luncheon was served at the St. Charles Hotel.

**American Society of Mechanical Engineers**

The thirtieth annual meeting of the Society will be held in the Engineering Societies Building, 29 West 39th Street, New York, December 7 to 10. The entire social entertainment will be in charge of the members resident in and about New York, under the immediate direction of a local committee appointed by them, of which Mr. William D. Hoxie, is chairman. For Wednesday afternoon, December 8th, an excursion is planned which members and guests will be asked to attend in a body, and during the balance of the time there will be opportunities for smaller parties to visit places of interest. In the evening, there will be a lecture for members and guests upon the subject of Agricultural Machinery.

The professional papers assigned to the meeting are as follows: Tests on a Venturi Meter for Boiler Feed, Chas. M. Allen; The Pitot Tube as a Steam Meter, Geo. F. Gebhardt; Efficiency Tests of Steam Nozzles, F. H. Sibley and T. S. Kemble; An Electric Gas Meter, C. C. Thomas; Tan Bark as a Boiler Fuel, David M. Meyers; Cooling Towers for Steam and Gas Power Plants, J. R. Bibbins; Some Studies in Rolling Mill Engines, W. P. Caine; An Experience with Leaky Vertical Fire Tube Boilers and the Best Form of Longitudinal Joint for Boilers, F. W. Dean; Testing Suction Gas Producers with a Koerting Ejector, C. M. Garland and A. P. Kratz; Bituminous Gas Producer, J. R. Bibbins; The Bucyrus Locomotive Pile Driver, Walter Ferris; Line-Shaft Efficiency, Mechanical and Economic, Henry Hess; Pump Valves and Valve Areas and A Report on Cast-iron Test Bars, A. F. Nagle.

In addition to the above papers there will be several valuable reports submitted by committees of the Gas Power Section.

**Engineering Society, University of New Brunswick.**

The annual dinner of the above society was held this week at Windsor Hall, Fredericton, N.B., the vice-president, Mr. J. B. Alexander, presided, and about eighty members of the society were present. It was probably the most successful function of its kind in the history of the society. After a seven course dinner had been enjoyed, the usual toast list was taken up and the various toasts were replied to by the following speakers: Chancellor Jones, Professors Stone, Stephens, Cartmel, Miller and Burchill, of the Engineering Department.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

8584—November 5—Approving by-law of the Temiscouta Railway Company authorizing F. X. Belanger, general freight and passenger agent, to prepare and issue tariffs of tolls to be charged for all freight and passenger traffic carried by said railway.

8585—November 4—Approving plan showing proposed overhead crossing at mileage 13.5 in the mountain section of the C.P.R. in Province of British Columbia.

8586—November 4—Approving Standard Freight Tariff C.R.C. No. 5 G.T.P. Ry., applying between G.T.P. Ry. stations in Province Saskatchewan and Province Alberta.

8587—November 5—Approving and sanctioning location of the C.N.O. Ry. Co.'s. line of railway through unsurveyed territory in Sudbury Mining Division, 120 miles from Sudbury Junction, Ont.

8588—November 4—Directing conditions under which the Grand Valley Railway Company may place double tracking of its line of railway along Colborne Street, Brantford, and regrade revision at intersection of Colborne and Market Streets in said city.

(Continued on page 604).

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.**—413 Dorchester Street West, Montreal President, George A. Mountain; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto. Meet last Thursday of the month.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coultee, Box 560, Ottawa; S. J. Chapleau, Box 203.

**MUNICIPAL ASSOCIATIONS.**

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES. — President, H. H. Gaetz, Red Deer, Alta.; secretary-treasurer, John T. Hall, Medicine Hat, Alta.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

## CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator Company, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE. — Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB. — President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, C. A. Jeffers; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY. — President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrell.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB. — President Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

## AMERICAN TECHNICAL SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS. — President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS. — President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

(Continued on page 50.)

# ASTRONOMICAL PAGE

**STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., DECEMBER 1st, IN LATITUDE 45° N.**

**L. B. Stewart, D.T.S.**

The table below gives the apparent places of the brightest of these stars for December 15th at transit across the meridian of 5h W. of Greenwich.

| Star | Mag. | R. A. h. m. s. | Decl. ° ′ ″ |
|---|---|---|---|
| α Andromedæ | 2.1 | 0 03 42.9 | + 28 35 40 |
| β Cassiop | 2.4 | 0 04 21.0 | + 58 39 23 |
| α Cassiop | 2.5 | 0 35 22.7 | + 56 02 48 |
| γ Cassiop | 2.3 | 0 51 15.3 | + 60 13 57 |
| α Ursæ Min. (Polaris) | 2.1 | 1 27 07.7 | + 88 49 46 |
| α Arietis | 2.2 | 2 02 05.4 | + 23 02 17 |
| α Tauri (Aldebaran) | 1.1 | 4 30 45.4 | + 16 19 47 |
| α Aurigæ (Capella) | 0.2 | 5 10 02.6 | + 45 54 30 |
| β Orioris (Rigel) | 0.3 | 5 10 13.0 | − 8 18 16 |
| α Orionis (Betelguex) | 1.2 | 5 50 18.1 | + 7 23 31 |
| β Ursæ Maj. | 2.4 | 10 56 24.5 | + 56 51 46 |
| α Ursæ Maj. | 2.0 | 10 58 10.5 | + 62 14 04 |
| γ Ursæ Maj. | 2.5 | 11 49 05.2 | + 54 11 34 |
| δ Ursæ Maj. | 3.4 | 12 10 57.6 | + 57 31 48 |
| ε Ursæ Maj. | 1.8 | 12 50 03.0 | + 56 26 44 |
| ζ Ursæ Maj. | 2.1 | 13 20 16.7 | + 55 23 34 |
| η Ursæ Maj. | 1.9 | 13 43 58.0 | + 49 45 36 |
| α Cygni | 1.3 | 20 38 19.6 | + 44 57 34 |
| β Pegasi | 2.4 | 22 59 23.2 | + 27 35 42 |
| α Pegasi | 2.6 | 23 00 15.2 | + 14 43 13 |

**Determination of Azimuth by the Pole Star.**

The following table gives the azimuth of Polaris on December 1st, 1909, for places in longitude 5h ( = 75° W.) and at certain standard times T:

| T. | Sid. Time | Lat. = 44 | | Lat. = 48 | | Lat. = 52° | |
|---|---|---|---|---|---|---|---|
| P.M. h. m. | h. m. s. | ° A ′ | a | ° ′ ″ | a | ° A ′ | a |
| 8 00 | 0 40 56.5 | 0 19 55 | −25 | 0 21 29 | −27 | 0 23 25 | −29 |
| 8 30 | 1 11 01.4 | 0 06 59 | −25 | 0 07 32 | −27 | 0 08 13 | −30 |
| 9 00 | 1 41 06.3 | 359 53 56 | −26 | 359 53 27 | −27 | 359 52 52 | −30 |
| 9 30 | 2 11 11.2 | 359 40 59 | −25 | 359 39 30 | −27 | 359 37 38 | −29 |
| 10 00 | 2 41 16.3 | 359 28 23 | −24 | 359 25 55 | −26 | 359 22 50 | −28 |
| 10 30 | 3 11 21.2 | 359 16 21 | −23 | 359 12 57 | −25 | 359 08 43 | −27 |
| 11 00 | 3 41 26.1 | 359 05 07 | −21 | 359 00 51 | −23 | 358 55 32 | −25 |
| 11 30 | 4 11 31.1 | 358 54 52 | −19 | 358 49 50 | −21 | 358 43 32 | −23 |
| 12 00 | 4 41 36.0 | 358 45 47 | −17 | 358 40 04 | −18 | 358 32 56 | −20 |

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.

CUT HERE FOR REFERENCE.

T = the time for December 1st.

L = the longitude.

d = number of days elapsed since December 1st.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° ( = 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on December 8th.

Here the interpolated value of the azimuth for 8h 30m is 0° 07′ 45″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 ( = 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

### Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) - (L - 5h)$.

Where

S = the required sid. time.

S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\ - S)\ (1 - 0s.16)$.

Where

T = the required standard time of transit of the star, and

T′ = the tabular time corresponding to S′.

$\alpha$ = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star $\alpha$ Arietis is observed at the watch time 9h. 13m. 44.6s. at the same place and date as above; to find its correction on standard time.

| | | h. | m. | s. |
|---|---|---|---|---|
| Sidereal time, 9h. 00m. (table) .... | = | 1 | 41 | 06.3 |
| 7 × (3m. 56s. 555) ..... | = | | 27 | 35.9 |
| | | 2 | 08 | 42.2 |
| Difference of longitude ..... | = | | 20 | 00 |
| S ..... | = | 1 | 48 | 42.2 |
| R.A. of star ..... | = | 2 | 02 | 05.4 |
| $\alpha$ — S ..... | = | | 13 | 23.2 |
| 13.2 × 0s.16 ..... | = | | | 2.1 |
| Equivalent mean time interval .... | = | | 13 | 21.1 |
| T′ ..... | = | 9 | 00 | 00 |
| T ..... | = | 9 | 13 | 21.1 |
| Watch ..... | = | 9 | 13 | 44.6 |
| Watch fast ..... | = | | | 23.5 |

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

## RAILWAY ORDERS.

(Continued from page 601).

8589—November 4—Authorizing the Montreal Park and Island Railway to construct, maintain, and operate spur in the town of Rosemount, P.Q.

8590—November 5—Approving and sanctioning location of the C.N.R. Company through Townships 5-2 and R. 6 west 2nd Mer., Sask., mileage 0.00 to 16.38.

8591—November 4—Authorizing the C.N.O. Ry to construct bridge over a ravine on Lot 30, Con. 5, Tp. Whitby, Co. Ont., Prov. Ont.

8592—November 4—Granting leave to the Calgary Power and Transmission Company to erect, place, and maintain its wires across the track of the Canadian Pacific Railway Company at Exshaw, Alta.

8593—November 4—Granting leave to the Calgary Power and Transmission Company to erect, place, and maintain its wires across the telephone lines and siding of the C.P.R. Co., leading into loder lime kiln, west of Kananaskis, Alta.

8594—November 5—Authorizing the Council of the City of Lachine, P.Q., to lay and thereafter maintain water pipe across the track of the G.T.P. Railway at Twentieth Avenue in said city.

8595—November 5—Amending Order of the Board No. 8314, dated October 12th, 1909, granting leave to the G.T.P. Railway to cross with its railway certain highways in the district of West Saskatchewan by striking out the crossings Nos. 1 and 3 in said Order.

8596—November 9—Granting leave to the G.T.R. to construct an additional railway track upon and across Romeo Street, City of Stratford, Ont.

8597—November 13—Granting leave to the Grand Valley Railway to cross the tracks of the G.T.R. with its second track in the City of Brantford, Ont.

8598 to 8603—November 4—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the track of the Canadian Northern Railway at six different points in the Province of Manitoba.

8604—November 9—Granting leave to the C.N.Q.R. to erect, place, and maintain its wires under the wires of the City of Quebec Telephone Company at Quebec Aqueduct, Parish of St. Sauveur, Co. Quebec, P.Q.

8605 to 8609—November 4—Granting leave to the Consolidated Telephone Company to erect, place, and maintain its wires across the tracks of the C.P.R. at five points in the Township of Caledon, Province of Ontario.

8610—November 4—Granting leave to the Bethesda and Stouffville Telephone Company, Ltd., to erect, place, and maintain its wires across the track of the C.N.O. Ry., Tp. Markham, Co. York, Ont.

8611—November 4—Granting leave to the Mt. Albert Tel. Company to erect, place, and maintain its wires across the track of the C.N.O. Ry at first crossing north of its station at Mt. Albert, Ont.

8612—November 5—Granting leave to the Bell Telephone Company to erect, place and maintain its wires across the track of the G.T.R. at P.C. ¾ mile east of Paris Junction, Ont.

8613—November 4—Authorizing the Corporation of the town of Berlin, Ont., to lay and thereafter maintain a sewer on Wilhelm Street across the track of the Elmira Branch of the G.T.R. in said town.

8614—November 10—Authorizing the C.P.R. to construct a station building (Standard No. 5) at Wilcox, Sask.

8615—November 5—Granting leave to the C.N.Q. Ry. to erect, place, and maintain its telegraph wires under the wires of the C.P.R. at Deschambault, Co. Portneuf, P.Q.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Nov. 21 1909 | 1908 | STOCK QUOTATIONS TORONTO Price Nov. 19 '08 | Price Nov. 11 '09 | Price Nov 18 '09 | Sales Week End'd Nov18 | MONTREAL Price Nov. 19 08 | Price Nov. 11 09 | Price Nov. 18 09 | Sale Week End'd Nov18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | $1,993,000 | 1,651,000 | | 1$4 | 177 | 465 | 178½ | 178 | 185 | 184 | (77½ | 176½ | 836 |
| Canadian Northern Railway | 2,986.9 | ..... | ..... | 357,900 | 257,600 | | | | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 885,456 | 816,743 | | | *1st. pref. 103½, 3rd pref. 60½, ordinary 20½ | | | | | | | | |
| T. & N. O | 334 | (Gov. Road) | | | | | | | | | | | | | | |
| Montreal Street Railway | 138 3 | 18,000 | 100 | 75,241 | 69,396 | | | | | 197 | 196½ | 208 | 206 | 206½ | 206 | 176 |
| Toronto Street Railway | 114 | 8,000 | 100 | 76,482 | 66,786 | | 123½ | 123 | 110 | 107½ | 106½ | 124 | 122½ | 124½ | | 80 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 170 | 184 | 184½ | 80 | 180 | | | 185 | | | |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## EARNINGS AND EXPENSES OF CANADIAN RAILWAYS.

| | Total Earnings. | Operating Expenses. | Ratio of Exp. to % of Earnings. |
|---|---|---|---|
| Mont. St. Ry., Oct., '09 | $ 354,006 | $ 174,734 | 49.35 |
| T. & N.O., Sept., '09 | 157,777 | 90,151 | 57.14 |
| Cape Breton Elec., Sept., '09 | 22,000 | 11,410 | 51.86 |
| G.T. of Can., Sept. '09 | 3,060,308 | 2,108,223 | 68.88 |
| G.T. West., Sept., '09 | 521,000 | 364,763 | 70.00 |
| Can. Atlantic, Sept., '09 | 184,443 | 160,223 | 84.57 |
| Can. Nor. Ry., Oct., '09 | 1,384,200 | 903,500 | 65.26 |

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto & York Radial Railway.
Windsor, Essex & Lake Shore Railway.
Ottawa Electric Railway.

## SOUTH-WESTERN TRACTION COMPANY, LONDON, ONTARIO.

President, F. G. Rumball.
General Manager, Mr. S. W. Mower.

**Kind of Road:** Interurban.

**Length of Road, in miles:**

Single track, 28.5.
Total in single miles, 28.50.

**Character of Service:**

Car equipment, 12 passenger, 2 freight, 1 locomotive.
Number of motors, two 93a westinghouse.
Power of motors, 60 horse-power.
Method of controlling, 202 Westinghouse.
Method of braking, air Westinghouse, automatic.
Gauge of track, 4-8½.
Weight of rails, 60 lbs.

**Power:**

Alternating current, 3-phase.
Voltage of transmission, 10,000.
Trolley voltage, 600.
Frequency of transmission for A.C., 25.

Note.—Three sub-stations each containing two 250 K.W. rotary converters (Westinghouse); six 125 transformers.

## NIACARA, ST. CATHARINES AND TORONTO RAILWAY COMPANY.

President, Frederick Nicholls, Toronto.
Superintendent, W. R. Robertson, St. Catharines, Ont.
Master Mechanic, William Pay, St. Catharines, Ont.

**Kind of Road:** Interurban, suburban or street railway

**Length of Road, in miles:**

Total in single miles, 50.

**Character of Service:**

Car equipment, 36; type, open, closed semi-convertible.
Number of motors, 4 per car; power of motors, 50 h.p.
Method of controlling, K and multiple unit.
Method of braking, air.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 80 lbs.

**Power:**

Direct current, D.C.
Voltage of transmission, 11,000 A.C.
Trolley voltage, 625.
Frequency of transmission for A.C., 60 C.
Number of phases, 3.

## TORONTO STREET RAILWAY.

President, Mr. William Mackenzie.
Manager, Mr. R. J. Fleming.
Superintendent, Mr. J. Gunn.
Purchasing Agent, Mr. A. M. Grantham.
Chief Engineer, Mr. William B. Boyd.

**Length of Road, in miles:**

Single track, 2 miles.
Double track, 56 miles.
Total in single miles, 114.

**Character of Service:**

Car equipment, No. C.G.E., 80.
Number of motors, 4.
Power of motors, 40 horse-power.
Method of controlling, series—parallel C.G.E. type K controllers.
Method of braking, storage air and hand brake.
Gauge of tracks, 4.10⅞.
Weight of rails, 70 and 90 lbs.

**Power:**

Direct current, 600 volts.
Alternating current, 110, 220 and 440 volts.
Voltage of transmission, 12,000.
Trolley voltage, 600.
Frequency of transmission for A.C., 25.
Number of phases, 3.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Nova Scotia.**

HALIFAX.—Tenders will be received until December 6th, for 3,000 feet of 2½-inch rubber hose, to stand a pressure of 300 lbs. per square inch on delivery, and 200 lbs. in ordinary fire service. A 3-year guarantee is required. Bids submitted some time ago, for the same material, on another basis, were returned. Mr. F. W. W. Doane is city engineer.

**Quebec.**

ARTHABASKA.—The secretary-treasurer of the council of the County of Arthabaska will receive up to Thursday, December 9th, tenders for the construction of a steel bridge on the Becancour River, between the municipalities of St. Louis of Blandford and the township of Stanfold. Louis Lavergne, secretary-treasurer.

HULL.—Tenders will be received until Monday, 6th December, 1909, for pumping equipment. R. W. Farley, City Engineer.

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

MONTREAL.—Tenders will be invited immediately by the St. Louis Council, whose secretary is Mr. Vincent, for tunnelling St. Lawrence street at the C. P. R. tracks. Further particulars may be obtained from the secretary or from Mayor Turcot.

MONTREAL.—Tenders will be received until Monday, November 29th, for the erection of an addition to Montcalm School, St. Hubert Street. Marchand & Haskell, Architects, 164 St. James Street.

**Ontario.**

COBALT.—Tenders will be received until Monday, December 6th, for grading required in connection with the construction of tracks at Cobalt, Ont. Further particulars are given in our advertising pages. Temiskaming and Northern Ontario Railway, 25 Toronto Street, Toronto.

COBOURG.—Tenders will be received up to Monday, the 6th December, for an 8-inch vitrified tile drain, about 2,000 feet in length and from 6 to 14 feet in depth. D. H. Minaker, Town Clerk.

TORONTO.—Tenders will be received until Wednesday, December 1st, for the work of All Trades in connection with the building of a large stone church on Bloor street east for St. Paul's Parish. Architect, E. J. Lennox, 161 Bay Street.

TORONTO.—Tenders will be received until December 7th for annual supplies, including:—Cement, gravel, paving materials, lumber, pipe, bricks, etc. Further particulars are given in our advertising columns. Mr. Joseph Oliver, (Mayor), Chairman, Board of Control.

**Manitoba.**

WINNIPEG.—Tenders will be received up to Tuesday, November 30th, for supply of 1,000,000 feet B.M. lumber required by the city of Winnipeg. M. Peterson, Secretary Board of Control.

**Alberta**

CALGARY.—Tenders will be invited by this municipality for six additional new steel cars of the pay-as-you-enter type. They are to be five feet longer than the cars now in use, and will be equipped with air brakes. Exclusive of the motors, it is expected that they will cost approximately $25,000, f.o.b. Calgary, for early spring delivery. Mr. J. T. Child is the city engineer.

WETASKIWIN.—Tenders will probably be invited at an early date for well drilling which will be undertaken by the municipality.

**British Columbia.**

VICTORIA.—Tenders will be received by the Vancouver Island Power Co., Limited, for a supply approximately 600 of cedar telegraph poles up to December 1st. A. Richardson, Purchasing Department.

VANCOUVER.—Tenders will be received by the secretary of the North Vancouver Ferries, Limited, until December 1st, 1909, for the furnishing of all materials, supplies, labor, tools, etc., necessary to construct and complete a reinforced concrete dock in North Vancouver in accordance with the plans, specifications, etc., prepared by George S. Hanes, B.A.Sc. Office of Engineer for the North Vancouver City Ferries, Limited.

## CONTRACTS AWARDED.

**Quebec**

SHERBROOKE.—The contract for the iron work on the new bridge over the Magog River has been awarded to McKinnon, Holmes & Co. at $21,700.

SHERBROOKE—The city of Sherbrooke recently undertook the replacement of all their wooden bridges with modern structures in steel and concrete. The first affected is known as the Saw Mill Bridge, consisting of two approach spans of 60 ft. and 75 ft. and one centre span of 168 ft. Plans were prepared for the sub-structure and the contract was let to a local contractor. Preliminary designs for the steel superstructure were also considered and it was decided to accept one having a concrete floor and of very substantial construction throughout. On receipt of tenders from several bridge companies, the contract was awarded to MacKinnon, Holmes & Company, Limited, who are now taking the work in hand to push the same to completion in the early spring. As an alternative to the bridge with concrete floor, tenders were requested for one with a creosoted wooden plank and block pavement, but on comparison of prices received it was considered advisable to make the additional outlay in order to have the entire structure of a most permanent nature. The prices were as follows:—

| Name of Builder. | Bridges with Wooden floor. | Bridges with Concrete floor. |
|---|---|---|
| Phoenix Bridge Co., Montreal..... | ..... | $27,500.00 |
| Jenks, Dresser Co., Sarnia..... | $23,500.00 | 25,000.00 |
| Structural Steel Co., Montreal..... | 19,450.00 | 23,100.00 |
| MacKinnon, Holmes & Co., Sherbrooke ..... | 19,750.00 | *21,700.00 |

*Accepted.

The plans were prepared by MacKinnon, Holmes & Co., Ltd., of Sherbrooke, Que.

**Ontario.**

ORILLIA.—The Canada Foundry Company, of Toronto, were recently awarded a contract by this municipality for supplying water mains required for extensions here at $34.20 per ton, f.o.b. Orillia.

OWEN SOUND.—The Owen Sound Iron Works Company have been given a contract by the Electric Light Department for the construction of a smoke-box, having an approximate weight of 5,330 pounds, at $263.05.

PETERBORO'.—Messrs. MacGregor and Reid will probably be awarded a contract amounting to $2,500 for plumbing, heating and tiling in connection with the new public library here.

TORONTO.—The Temiskaming & Northern Ontario Railway Commission has awarded contracts for the construction of sixty two new freight cars. The Dominion Car & Foundry Co. of Montreal, submitted the lowest tender, and will build the cars. This new addition to the rolling stock will comprise fifty forty-ton standard box cars, with steel under frames, and twelve cinder or general service cars.

TORONTO.—Contracts totalling $52,784 were awarded at a recent meeting of the Board of Education. Among them the following recommendations for the Logan Avenue school were made: Masons' work, Wickett Bros., $24,809; carpenters' work, W. Williamson, $12,695; plasterers' work, Hanna & Nelson, $3,414; painters' work, J. Phinnemore, $1,245; plumbers' work, F. Armstrong Company, $1,725; roofers and tinsmiths' work, A. B. Ormsby Company, $1,070; heating and ventilating work, J. R. Seager, $4,850; heat regulation, Johnson Temperature Regulation Company, $775; electric wiring, Hall & Dollery, $38; structural steel, Reid & Brown, $2,073. It was recommended that Jones Bros. & Company's tender for $400 for cupboards at Harbord, Jameson, and Riverdale Collegiates be accepted; also the T. Eaton Company's tenders for $110 for fifty stools in the Industrial Art Department of the Technical High School. The following tenders were recommended for Jones Avenue School: Electric wiring, Hall & Dollery, $50; heat regulation, Johnston Temperature Regulation Company, $477. The tender of the Charles Rogers Company for cupboards in nineteen public schools for $2,255 was also recommended.

**Manitoba.**

WINNIPEG.—The Board of Control recently considered the following tenders for sewers and water mains:—

| | T. Jackson & Son. | Engineer. |
|---|---|---|
| Sewer, Morley Avenue | $ 980 25 | $ 1,007 45 |
| Sewer, Chalmers Avenue | 3,585 60 | 3,635 50 |
| Sewer, McIntosh Avenue | 1,612 55 | 1,630 47 |
| Sewer, Clifton Street | 23,612 55 | 23,182 35 |
| Water main, Poplar Avenue | 458 40 | 425 84 |
| Sewer, May Street | 431 70 | 422 02 |
| Sewer, Nassau Street | 455 50 | 442 75 |
| Sewer, McMillan Avenue | 729 90 | 725 72 |

In each case the lowest tender will be accepted.

**British Columbia.**

VANCOUVER.—Bids for the construction of a bridge over False Creek were received on November 12th. The structure is to be about 3,375 feet long between abutments and is composed of a 264 ft. centre bearing, electrically operated, swing span, carried on concrete piers, which are to be sunk by the pneumatic process, and sixty-six deck plate girder spans varying from 35 to 80 ft. in length, and supported on steel bents resting on concrete pedestals of which sixty are to be placed on piles and fifty on earth. Approaches, each about 150 feet long, consist of concrete retaining walls and abutments with earth fill. The bridge carries two wooden sidewalks, each 6 feet wide, and a roadway 44 feet wide, paved with creosoted wood blocks on creosoted planks and ties. Two electric railway lines are at the centre of the roadway and the bridge will be lighted electrically. Tenders were received on the following basis: 1st.—For metal work and all other superstructure materials erected. 2nd.—For substructure complete.

The following were received for the superstructure:—
A—Dominion Bridge Co., Montreal, Quebec.
B—Canadian Bridge Co., Walkerville, Ont.
C—Evans, Coleman & Evans, Vancouver, B. C.

| | A | B | C |
|---|---|---|---|
| Metal and machinery in swing span and gates, including light brackets, but exclusive of electrical equipment, per lb. | 6.08c. | 6 2/10c. | 6½c. |
| Metal in trestle span and trestle bents, per lb. | 4 44 | 4.27 | 5 4/10 |
| Electrical motors for the operation of gates in swing span and controllers, etc. | $1,070 | $2,000 | $1,500 |
| Creosoted timber, including piles and stones necessary for attachment, per thousand ft. | $50.65 | $45.00 | $50.00 |
| Untreated native timber, per thousand feet | 78.00 | 30.00 | 28.00 |
| Untreated Australian hardwood | 78.00 | 80.00 | 75.00 |
| Paving complete, per square yard | 2.25 | 2.00 | 2.10 |
| Draw protection piles per lin. ft. | .35 | .35 | .25 |
| Electric lighting equipment, except brackets on substructure, complete | $8,500 | $8,000 | $10,000 |
| Machine house on swing span | 500 | 600 | 750 |

The certified cheque for the Dominion Bridge Company, based on 10 per cent. of the estimate, was for $40,000; for the Canadian Bridge Company, $50,000, and for Evans, Coleman & Evans, $52,000. Roughly estimated, according to the quantities, the compilation works out at: Superstructure—Dominion Bridge Company, $458,864; Canadian Bridge Company, $439,210; Evans, Coleman & Evans, $519,305. The tenders for the superstructure are totalled on the basis of Australian hardwood being used to pier protection, which is optional.

For No. 2, substructure complete, tenders were received as follows:

| | |
|---|---|
| Palmer Bros. & Henning | $218,620 |
| Armstrong & Morrison | 224,480 |

The tenders were referred to the consulting engineers, Messrs. Waddell & Harrington, of Kansas City, Mo., who will make another estimate of the cost of the bridge from the quantities and the prices given and recommend the tenders for acceptance. The quotations for the metal per pound in the spans, which is one of the principal items, are appreciably below the figure for the metal in the last bridge.

## RAILWAYS—STEAM AND ELECTRIC.

**New Brunswick.**

FREDERICTON.—The C. P. R. is to make a thorough and practical test of Grand Lake coal on their locomotives on freight trains running between McAdam Junction and St. John. If satisfactory an extensive development of the Grand Lake coal areas will follow.

ST. JOHN.—Delays have been met with in the building of the electric railway which is to run for twelve miles into Aroostook Junction to connect with the C.P.R., which will prevent its completion before the first of the year. Mr. Goold, of Presque Isle, chief owner of the road, recently said that the opening of the road had been delayed for about two months, chiefly by the wet weather. All of the grading was completed some time ago, and the rails are now on the ground, but work at the several bridges on the line has been held back. This is the first electric road in this part of America of standard gauge.

**Quebec.**

MONTREAL.—The C. P. R. is considering a proposal to prevent smoke nuisance in this city by operating trains within the city limits by electric power.

MONTREAL.—Another important link in the Canadian Northern Transcontinental Railway System will be opened on the 28th of this month. This comprises 265 miles between Ottawa and Quebec, and will furnish the shortest and most direct route between these two cities. The completion of this road was delayed owing to the Railway Commission's objections to their terminal facilities at Ottawa, but for the present temporary quarters will be used.

MONTREAL.—On November 16th the Dominion Railway Commission, sitting at Ottawa, heard the case respecting the subway in St. Louis, which is to cost $200,000. The C.P.R. will contribute $50,000, the Park and Island Railway will pay $15,000, while $10,000 will be taken from the parliamentary fund for the abolition of level crossings and the remainder will be provided by the town.

SHERBROOKE.—Mr. W. Hibbard, of Montreal, met the city council recently and made a proposition for a new company getting control of the street railway. They would extend the system throughout the city, and would ultimately run to Magog. He wanted the city to sell Westbury Basin power, now held by the city, at $22,000, and asked that a franchise be given for fifty years. During the last thirty years the city would come in for a percentage of the earnings.

**Ontario.**

CORNWALL.—The council of Cornwall Township and the Cornwall Electric Street Railway Company have formed an agreement by which the company receives a franchise to extend their line up the West Front road over Wood's Hill to the O. & N. Y. Railway depot. The line at present makes a detour by the Toronto Paper Company's mills. The straight line will be about half a mile shorter.

GUELPH.—It is understood that the Canadian Pacific Railway has made the city a most important proposition in connection with the dangerous level crossings in the city

and this proposition will be considered at an early meeting. The proposition of the company is that it will protect the Eramosa Road and Heffernan street crossings by the erection of overhead bridges if the city will undertake the responsibility of protecting Allan's crossing.

GUELPH.—On Thursday the 18th November, the Ontario Railway and Municipal Board ordered the city of Guelph and the Guelph Radial Railway Company, to forthwith construct a new four-span steel bridge over the Speed River on the Dundas Road, in accordance with the report of Mr. F. L. Somerville, C. E., upon good and substantial stone or cement piers. Arrangements were some time ago made by Manager Hackney and the money provided to rebuild the bridge, but it takes time to secure steel such as is intended to be used—the heaviest obtainable on the long spans and a little lighter on the shorter ones. Though efforts will be made to hasten it along, it is hardly likely the steel can be secured before January.

PORT ARTHUR.—To promote better service and faster running time in both freight and passenger departments the C.N.R. will, in the spring, construct many side tracks between here and Winnipeg. The existing sidings and spurs will be lengthened, this being necessitated by the fact that higher percentage engines now being used on first district can pull longer and heavier trains and require longer siding to contain the entire train when a meet is rendered necessary. When all this necessary improvement work is done much better running time can be made between Port Arthur and Winnipeg, and also between Port Arthur and Duluth. The laying of heavy eighty-pound steel rails between here and Winnipeg is practically completed, there only being about seven miles more to lay in the vicinity of Lazine.

ST. THOMAS.—The new subway under the Michigan Central Railway tracks at Ross Street, constructed at a cost of $60,000, was formally opened on Monday afternoon.

TORONTO.—Mr. J. W. Moyes, who was appointed to report on tube railways for Toronto, has recommended the establishment of a dual system of underground and surface railways to cost $4,485,000. The underground system would be 3¾ miles long. The outgoing section would be served by surface railways.

**Alberta**

EDMONTON.—Dirt will be made to fly on the Alberta and Great Waterways railway this fall. The men and the money are available and only adverse weather conditions will prevent a good deal of grading being done during the winter months.

EDMONTON.—For the first time in many months the street cars of Edmonton were operated on time the other day when one of the three new engines supplied by Messrs. Belliss & Marconi was set in operation. Lack of power has been responsible for the unsatisfactory service given during the past year. The new equipment promises to supply abundant power for some time to come.

FRANK.—The survey party in the employ of the Caribou Hill Coal Company, running a railroad survey up the South Fork of the Old Man River to cross the main range via the North Kootenay pass, is now nearing the summit and it is expected the work will be completed before severe weather sets in. Engineer Winters, in charge of the work, states that as good progress as can be expected under rather unfavorable conditions is being made and that he expects to finish the survey to the summit at least. Contrary to the supposition that has been general with regard to the building of a railroad through the Kootenay Pass, which has been that a long tunnel at the summit would be necessary in order to get a reasonable grade, Engineer Winters says no tunnel will be necessary and that a very fair grade will be obtained. That it is a bona fide railroad and not merely a preliminary designed to head some one else off, is indicated by the fact that the road is being located as the work progresses, leaving only the cross-sectioning to be done. It is said that contracts will be let early in the spring for construction. The line will connect with the Crow's Nest road at Burmis.

**British Columbia.**

NEW WESTMINSTER.—The length of the new British Columbia Electric railway line to Chilliwack will be sixty-four and a half miles and will be bedded on a good grade. The sub-grade has been completed over two-thirds of the entire road. At the rate of one mile per day the rails, which are seventy pound steel, have been laid to Langley Prairie. No grade on the entire road will be greater than two and five-tenths per cent. The power to operate the line will be supplied by the station at Lake Buntzen, coming over the high tension lines in its full voltage, to be reduced to operating voltage by the five substations located at Chilliwack, Sumas Mountain, Clayburn, Mt. Lehman and Cloverdale. The reduction stations will be reinforced concrete structures and will each represent to the company for the buildings alone an expenditure of $25,000 to $35,000, while the machines therein will be 300 to 600 kilowatt power. The system will be operated on standard time. The rolling stock will consist of a combination train, including freight cars. These cars will be operated under the multiple unit system and coupled by the A. M. M. type of air and the junction box electrical connection and will run jointly under one motorman, at the same time each car propelling itself. The new controller differs from that in use at present by being only about a foot square but having about three thousand connections with the group switch. For freight transportation the company has purchased three fifty-ton motor locomotives. One of these motors is in use at present having arrived about a week ago, and is giving perfect satisfaction.

VANCOUVER.—The survey of the Canadian Northern route to tide water is being rushed. An engineering party is now locating the line west of Chilliwack, about sixty miles east of this city. The line will follow the south bank of the Fraser all the way to a point opposite New Westminster. Another survey party is now locating the line down the main Thompson River, between Kamloops and Lytton.

## SEWERAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—The city's conduit was recently completed at a cost of three-quarters of a million dollars. The construction work occupied about two years.

**British Columbia.**

VANCOUVER.—The detail work in connection with the proposed sewage disposal system is completed and the money will probably be voted for at the January elections.

## LIGHT, HEAT, AND POWER.

**Ontario.**

GALETTA.—The Galetta Electric Power Co. are now supplying the town of Arnprior with electricity. They recently installed considerable new plant, which was supplied by the Canadian Westinghouse Co.

TORONTO.—A meeting of the municipal engineers of Ontario and others interested in the proposals of the Hydro-Electric Power Commission was held in the City Hall, Toronto, on November 16th and 17th. Mr. R. A. Ross, C. E., of Montreal, who has been presiding at previous meetings, was absent through sickness, and Mr. P. W. Sothman, chief engineer of the Hydro-Electric Commission, occupied the chair. The afternoon of the first day was taken up with a report of the committee previously appointed to investigate the question of street lighting. Engineers expert on this subject also addressed the meeting. Mr. E. I. Sifton, electrical engineer of London, Ontario, presided at the meeting held on the second day, when standard transformer specifications and questions of thirteen-thousand-volt insulators and single versus three-phase transformers were discussed. The principal feature of this meeting, however, was a debate on the question of rates for incandescent lighting. It was decided that the method of charging best adapted for general use was one which bases a fixed monthly charge on the floor space of a house, together with a similar charge per k.w. hour. Power rates were next considered, and a committee was appointed to investigate the question. The next meeting is to be held in London, Ont., on December 14th.

**Alberta.**

CALGARY.—Superintendent McColl, of the city power house, has outlined plans for a new power plant.

RED DEER.—The town officials are negotiating with the Western General Electric Co. with a view to purchasing their plant.

## FINANCING PUBLIC WORKS.

**Quebec.**

MONTREAL.—The real estate owners of Montreal will vote on December 21st on a $2,000,000 lighting plant by-law.

MONTREAL.—The council have passed a $10,000 new pavement by-law.

**Ontario**

GUELPH.—Guelph has made a sale of debentures at an unusually high rate to the Ontario Securities Company. The rate was above 100, being a lump sum of $54,074 for $50,000 debentures for the installation of the Hydro-electric distributing plant.

INGERSOLL.—The ratepayers of Ingersoll will vote on a by-law for a civic power distribution plant in January. It is estimated that the plant will cost $26,000. A plant for a lighting service would cost $50,000 more. If the by-law passes the existing plant will likely be bought out.

NIAGARA FALLS.—A by-law to borrow $11,000 to meet Centre Street paving work, was read a first, second and third time.

ST. MARY'S.—The by-law to grant a bonus of twenty thousand dollars to the St. Mary's & Western Railway was voted on by the township of Blanshard last Friday, and carried by a majority of four. A similar by-law was carried last May, but upon protest for irregularity was quashed.

SMITH'S FALLS—By-laws to provide $16,000 for waterworks plant and $46,000 for a new collegiate institute will be submitted at the next elections.

**Manitoba.**

BRANDON.—A by-law is ready to submit to the electors authorizing the council to borrow $10,000 to be spent on the three leading roads leading into the city from the north.

**Alberta.**

MEDICINE HAT.—The ratepayers will vote this week on a $9,000 by-law for a site for Alberta Clay Products Co.

**British Columbia.**

NANAIMO.—The council have adopted the waterworks by-law, 1900, and are reconsidering the local improvement by-law for the construction of permanent sidewalks.

NEW WESTMINSTER.—The ratepayers have passed a by-law for $308,000 local improvement debentures.

SANNICH.—The ratepayers will vote on a $7,000 by-law to provide for draining.

Debentures are offered for sale by the following municipalities:—

**Ontario.**

PETROLEA.—$14,535.80, pavements; $4,000, bridge; $2,000, local improvements.

STAMFORD TOWNSHIP.—$8,700, local improvements.

**Saskatchewan.**

YORKTON.—$40,000, high schools.

The following municipalities recently sold debentures:—

GLEN EWEN, SASK.—$1,000, waterworks. FERNIE, B.C.—$25,000. COLCHESTER NORTH, ONT.—$9,633. OUTREMONT, QUE.—$50,000, schools. CHATHAM, ONT.—$20,000, high schools. ORILLIA, ONT.—$143,000, sewerage, park, schools, etc. COUNTY OF ELGIN, ONT.—$20,000, house of refuge. MARKDALE, ONT.—$10,000, waterworks and fire hall. VICTORIA COUNTY, ONT.—$20,000, bridge and improvements. PORTAGE LA PRAIRIE, MAN.—$70,000, waterworks. NORTH VANCOUVER, B.C.—$35,000 and $17,474. ST. STEPHEN, N.B.—$100,000, waterworks.

## COMING MEETINGS

**American Institute of Architects.**—December 11-16. Annual convention at Washington, D.C. Secretary, Glenn Brown, The Octagon, Washington, D.C.

**The Nova Scotia Society of Engineers.**—December 9th. Paper on the Improvements of the Telephone, by J. H. Winfield, the general manager, N.S. Telephone Company. Secretary, J. Lorne Allan, Provincial Engineer's Office, Halifax, N.S.

## PERSONAL NOTES.

MR. JAMES GOODWIN, of Chicago, succeeds Mr. P. J. Slattery as manager of the Sherbrooke Street Railway Co., of Sherbrooke, Que.

MR. JAMES MILNE, M. Can. Soc. C.E., M. Am. Soc. M.E., recently resumed his consulting practice, and now has an office in the Loo Building, Vancouver, B.C. Having the benefit of many years' experience in connection with the development of power, the construction, maintenance and operation of electric railways and other municipal problems, Mr. Milne is prepared to handle work which is related to electrical, steam and mechanical engineering from the preparation of plans and estimates to the supervision of construction and operation.

## OBITUARY.

MR. JOHN MACVICAR, a well-known railway contractor of Goderich, Ont., died at Toronto this week. Mr. MacVicar was sixty-nine years of age.

MR. CHARLES COURSOL, of Ottawa, who was in the engineering department of the National Transcontinental Railway and a former student of the Royal Military College, Kingston, died on Tuesday, November 23rd.

MR. J. C. WILSON, of J. C. Wilson & Company, mechanical engineers, Glenora, Ontario, died at Picton, Ont., on Friday, the 12th November, after an illness of some months. He was the son of the late Mr. Stewart Wilson, who came to Canada from Albany, N.Y., in the early part of the nineteenth century. On Mr. Wilson's arrival in Picton, he established the first foundry in Upper Canada, then known as the Phenix foundry, where the first plowshare was cast in Upper Canada. Mr. James Canniff Wilson was born in 1833, and on reaching the age of thirteen years his father purchased for him the property then known as "Stone Mills," some five miles east of Picton, on the shore of the Bay of Quinte, now known as Glenora, which comprised at that time a saw mill, grist mill, and woollen mill. The grist mill was operated by Sir John A. Macdonald's father for two years before Mr. Wilson got control. Even although young Wilson was only thirteen years of age when he first entered business he made a success of the venture. During the summer he operated the mills and in the winter months was a scholar at the McMullen Academy. The mills were burned about forty years ago and were rebuilt on a larger scale. In 1876 Mr. Wilson branched out into the manufacture of turbine water wheels and mill machinery, and built up a large and flourishing trade. A good part of the product being disposed of through a London, Eng., agency. Mr. Wilson conducted this business until seven years ago when he was succeeded by his son, Mr. F. S. Wilson, who now continues the business in the old firm name of J. C. Wilson & Company.

## MARKET CONDITIONS.

Toronto, November 25th, 1909.

After weeks of soft or rainy weather, frost has come. Sleet and mud were not favorable to movement of cement and stone, but bricks have continued to show much activity in the city. Lumber moves fairly well and other building materials maintain activity and price in the city.

Stocks of iron and steel goods in the hands of merchants are much reduced, and with the increased activity of retail demand must soon be replenished, possibly at increased prices. American quotations are apparently going higher; so great is the pressure on steel mills there that they ask from 2 to 6 months' time to fill orders, according to description or dimension of goods. In builders' hardware and shelf hardware generally, the Ontario demand is brisk.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Bniler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.40 without bags, or $1.70 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady. A good deal moving in filling former contracts.

**Coal.**—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50.

**Copper Ingot.**—Demand quite heavy, and price advanced to 14¼c. Supply adequate.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite**, per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs. Much is being now used for lumber camps.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.68; 4-inch, $30.76; 4½-inch, $38; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, weak, and rather over-stocked, $3 to $3.10; lath, No. 1, $4.40, white pine, 42-inch; No. 2, $3.75; for 32-inch, $1.60.

**Nails.**—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.0c. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—Dealers report a large demand, the prices being as before, per catalogue

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7. There is still a scarcity of good slaters and much demand for them.

**Rope.**—Sisal, 9¼c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 71 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $41.

**Sheet Steel.**—We do not alter prices as yet; 10-gauge, $2.50; 12-gauge, $2.55, American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24 gauge, $2.60; 26-gauge, $2.60; 28-gauge, $2.85. Quite a good demand exists, and there is prospect of higher prices.

**Sheets Galvanized.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. Demand very active.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

## CAMP SUPPLIES.

**Beans.**—Hand picked, $2; prime, $1.90.

**Butter.**—Dairy prints, 21 to 22c.; creamery rolls, 26 to 27c.

**Canned Goods.**—Peas, $1.00 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; corn, 75 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¼c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ½c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 9½c.

**Eggs.**—New laid, 25 to 26c. per dozen, in case lots.

**Lard.**—Tierces, 15½c.; tub, 16 to 16½c.; pails, 16c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 75c. a bag.

**Pork.**—Market uncertain. Short cut, $28 per barrel; mess, $26.50.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 14 to 14½c., tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 14½ to 14¾c.; breakfast bacon, 17c.; backs (plain), 18 to 19c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked. Market very firm.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

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Montreal, November 23rd, 1909.

The pig-iron market in the United States is quiet and some sales have developed at lower prices. This remark applies to foundry iron. It would seem that speculators some time ago purchased heavily of southern iron to be held in store for a definite period and that this period has now expired and the owners are being compelled to move it out of store. In order to get rid of it they are prepared to accept lower figures than previously. This has upset the general market for the time being to the extent of about 50c. per ton. Steel-making brands are in good demand and are selling at well maintained prices. As a result of the concessions mentioned, the turn-over is exceptionally large, purchasers evidently feeling that this is an opportunity to cover their wants at prices which are not likely to be long repeated. The general trade for steel purposes is exceptionally good, all classes of finished and semi-finished goods being in good demand, and the outlook for the future being quite promising.

The English market is quiet and steady. There is practically no feature worth speaking of and prices vary between previous ranges. Demand from home and abroad continues steady, as previously.

In the local market, the most prominent feature is the closing of navigation. The final preparations for the laying up of the boats is now going on and inside of another week the streams may be coated over with ice. Metal reaching here by the last ships is now being moved off the docks as rapidly as possible and sent forward to customers. These supplies will help to keep Canadian foundries going for some time to come, but, as an evidence of the feeling that the market is likely to show further advances, enquiries are now being received for a heavy tonnage of pig-iron extending over the second and third quarters of 1910. The large buyers all over the country are beginning to enquire for future delivery, so that holders are maintaining the strong tenor of the market. The quotations on pig-iron, given below, are about the same as previously, but next week's figures will be for iron in store, as by that time practically everything will have been moved off the docks.

The remainder of the market, so far as quotations are concerned, is steady and unchanged, but it is expected that in another week there will be some alterations. Among other things, the tone of the market for bar iron and steel is very firm, and, although no changes have yet been registered, something is expected shortly. As for plates, etc., the market continues very quiet, and the tone is little more than steady.

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¼-base; tire steel, $1.00 for 1 x ¼-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c., 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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## The Canadian Engineer

ESTABLISHED 1893.

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**Editor**—E. A. JAMES, B.A. Sc.

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TORONTO, CANADA, DECEMBER 3, 1909.

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## PARLIAMENT AND THE CEMENT MERGER.

Of the many recent mergers, the Canada Cement Company appears to be attracting the greatest attention. The product of the cement plant has come into such general use that all classes are interested in the quality, quantity and price of its output, and when anything is done that has the appearance of affecting the output or its price there is a general interest expressed. Just now that interest is taking the shape of appeals to Parliament.

These appeals are worth considering. It will be noticed that it is not complained that the quality of Canadian cement will be injuriously affected; in fact, it may be expected that consolidation will improve the output, as all mills will have the opportunity of availing themselves of the best practices of the best mills in the syndicate.

Nor do they suggest that the output will be diminished. It is first and last with those now opposing the new order of things a question of price.

Few mills in Canada have produced cement at much less than seventy cents per barrel. In most mills the cost has been above that. Seventy cents to manufacture, twenty-five cents for management, another twenty cents for the middleman, and, say, twenty-five more for freight rates, and this will give cement to the consumer at one dollar and forty cents per barrel. Not an excessive price.

For the last year prices of cement have been below that figure—thirty and forty per cent. below, but it was well known that in some cases it was being sold below cost. Should such an uncertain market price continue, one of two things must result—mills close down or an inferior brand of cement turned out. Either would demoralize construction work. Neither will now occur—the merger will guarantee a good cement, the consolidation will mean a uniform price, a price at which cement can be well made; for it is just as necessary that the manufacturer be protected by a fair price for his product as for the workman to be protected by a fair wage clause in contracts.

The price of cement is not likely to advance very much. Cement was imported into Canada during the 1909 season when prices were low and uncertain, and if it came in when prices were low the American producer will not allow prices to go very high before he will come after Canadian business so strong that prices will remain around the dollar thirty mark.

## CURRENTS IN LAKE ONTARIO.

We publish in this issue a very interesting paper by Mr. F. Walter Thorold, B.A.Sc., on "Lake Currents Near Toronto." This question has been long discussed, and has been the subject of much theorizing. It is refreshing to receive some definite information.

As a local problem it is a matter of considerable interest, but the method of dealing with the question, the making and placing of floats, the system of recording position of floats, and the general deductions are of interest to those having similar conditions to investigate.

## THE ENGINEER A GOOD GUESSER.

The number of disasters, failures and law suits that have grown out of the phrase, "I guess," are legion, and yet the engineer must be a good guesser, must train the faculty of guessing, and frequently use it.

There are times when the public demand too much from the engineer in the way of a guess. Sometimes they expect him to view the location and then give an estimate. Clients write an incomplete letter, believing they can get an estimate by return mail. All this may be very absurd, yet the engineer requires to be a good guesser.

He may prepare his plans, his detail drawings, write specifications in detail, and complete his bills of material. For his estimate he must guess.

Sometimes the guess is a good one. Recently in a large public work the estimate was $450,000. The contract price was $442,750—a pretty good guess. We also know of work where the estimate was $150,000 and the contract price about $46,000. The guess was not so good. On a $50,000 bridge the tenders ranged from 20 per cent. below to 20 per cent. above the estimate. All this goes to show that the engineer requires to be a good estimator, but that at best he is frequently only a guesser—sometimes good, sometimes not so good.

It is not enough that the engineer be skilled in design and specification writing. He must be able to estimate with a reasonable degree of accuracy, and to do this he must study the contractor's methods and view the work from his point of view. He may take the average of a dozen similar works, and yet fail to consider the one item that may put this particular work in a class by itself. Erratic estimating makes it difficult for the contractor and difficult for the engineer. In view of this, we would say to the engineer: "Train yourself to be a good estimator, a good guesser."

Among the innumerable subjects, from steel under stress to the extermination of mosquitoes, with which the engineer is supposed to be familiar, dependable guesswork should not be neglected.

## EDITORIAL NOTES

The twenty-fourth annual meeting of the Canadian Society of Civil Engineers will be held at Ottawa, Ont., on Wednesday, Thursday and Friday, January 27th, 28th and 29th, 1910. We hope to be able to say more about the details of this meeting in the near future.

* * * *

Christmas time has many special calls. The columns of this journal are devoted exclusively to engineering problems, but once a year we remind you of the suffering little ones in the Hospital for Sick Children, Toronto. Mr. J. Ross Robertson, chairman of the Executive, will be very glad if you will co-operate with the hospital authorities to help in making life brighter and easier to bear for the thousand and more unfortunate little ones who come to them for help and healing.

* * * *

The question of scientific forestry is again receiving much attention in Canada. Two of the largest Canadian Provinces are actively enquiring into the forestry problem and its solution. British Columbia have a commission of three, who are engaged in gathering information as to administration and conservation of forest wealth, and Quebec expects that at the coming meeting of the Legislature provision will be made for a School of Forestry in that Province.

## COMING MEETINGS.

**American Society of Refrigerating Engineers.**—December 6. Annual meeting in New York City. Secretary, Wm. H. Ross, 154 Nassau Street, New York City.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton, H. Moore, Butte.

**American Institute of Chemical Engineers.**—December 8-10. Annual meeting at Philadelphia, Pa. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

**American Association for the Advancement of Science.**—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

**American Society of Agricultural Engineers.**—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

**Association of American Portland Cement Manufacturers.**—December 14-15. Annual meeting at New York City. Secretary, Percy H. Wilson, Land Title Building, Philadelphia, Pa.

## The Engineers' Club of Toronto

96 KING STREET WEST TELEPHONE MAIN 4977.

### Programme for December, 1909

THURSDAY, DECEMBER 2nd.

Discussion:

City Passenger Transportation (Surface, Underground and Elevated).

THURSDAY, DECEMBER 9th.

"Electrical Distribution." Illustrated by lantern slides.

*Paper by Mr. P. W. Sothman, Dr.E., Chief Engineer, Hydro-Electric Commission.*

THURSDAY, DECEMBER 16th.

ANNUAL MEETING.

Election of Officers, etc.

Motion by Mr. Somerville to amend the Constitution to admit *Associate Members.*

Motion by Mr. Murray to raise the annual dues from $5 to $7.50.

THURSDAY, DECEMBER 23rd.

A Social Evening.

THURSDAY, DECEMBER 30th.

Meeting of the Toronto Branch of the Canadian Society of Civil Engineers.

THE EXECUTIVE MEETS EVERY THURSDAY AT 7.30 P.M.

A. B. BARRY, President, City Hall.

L. J. STREET, Treasurer, 37 Melinda St.

R. B. WOLSEY, Secretary, 25 Lowther Ave.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## IS PURIFICATION OF WATER BY STERILIZATION A DREAM?

Mr. Allen Hazen, of New York, the other week at a meeting of the Canadian Society of Civil Engineers at Toronto, in answer to a question referring to ozonization of water, made answer that, to his mind, the question of sterilizing water was a dream.

He admitted that he had no experience with ozone treatment in practice, although he was conversant with a few experiments.

He stated that a "man" called at his office lately in connection with some work he had in hand for a client and offered to purify water by ozone, giving almost any kind of guarantee. Being curious as to the exact kind of guarantee, he asked for a definition, and was informed that the guarantee consisted of "killing all the pathogenic germs in the water." Mr. Hazen, believing that there were no pathogenic germs in the water, refused the guarantee.

If ozonization of water or sterilization meant dealing with a water whose only impurity lay in the presence of pathogenic germs, one could understand the value of any such guarantee. But, as a matter of fact, purification of water generally means the removal of many things from the water which are not germs, and which are possibly sterile to commence with.

At the time when the above statement was made by Mr. Hazen, Dr. Sheard, Medical Health Officer of Toronto, stated that he had now been examining Lake Ontario water for many years, and had never yet succeeded in discovering any pathogenic germs in the water.

Now it occurs to us that if we have men who are willing to offer guarantees of the above nature, it will be as well to have a definition of pathogenic germs. Turning to Gilbert E. Brooke's "Essentials of Sanitary Science," we note a definition on page 186: "Bacteria which cause disease in the higher animals or man are dubbed "pathogenic." The pathogenic germ which is most feared in our water or wilk supply is certainly the "typhoid bacillus"; and this bacillus is seldom, and one may say, never found in water, no matter how intense the examination may be.

Rickards in the "Quarterly Bulletin, Ohio State Board of Health" for July-September, this year, states:—

"During the last few months, when typhoid has been very prevalent, especially in the rural districts, the hygienic laboratories have been called upon to make more examinations of private water supplies than ever before. Perhaps a third or more of the requests for examinations of water from private sources because of typhoid in the family or neighborhood have been, not requests for sanitary water analyses, but for an examination for the typhoid bacillus itself. As all bacteriologists are unanimously of the opinion that such examinations are useless, we have invariably refused to make them, and have instead, where the circumstances warranted it, made chemical and bacteriological examinations. The former tests show the amount of organic matter present; the latter show us the total number of bacteria of all kinds, and a further test is made for the presence of bacillus coli, a normal inhabitant of the intestines of man and animals. This organism, which is always found in countless numbers in all human and animal feces, is almost invariably confounded by the newspapers with the typhoid bacillus, and this may account for the widespread impression that we examine for the latter."

If, then, it is next to useless to examine water for pathogenic germs, we must agree with Mr. Hazen that the guarantee offered was of little value.

Is ozonization a dream? Well, if it is, we must confess that there are a lot of very eminent scientific men in the world at present walking in their sleep. Whether it be possible or not to discover pathogenic germs in water, we know that there are occasions when they are present, and we know that there are waters which are so contaminated with sewage that the risk of their presence is constant. The bacillus coli may only be an index to sewage contamination, but we know that the typhoid infection is carried by sewage, and that water is infected thereby. We know that filtration, if properly worked, will remove 99 per cent. of the bacteria in the raw water, and we, therefore, know that for every hundred bacteria in the raw water, we may be left with one. Therefore, we know that water containing 500,000 bacteria per c.c., as some waters do, when filtered will still contain 5,000 bacteria per c.c.

Now, in some places this is the only possible water that people can get to drink, water which contains 50 times more bacteria than is allowed for by the German standard of purity. What are these people to do?

It is all very well to say that sterilization is a dream. But is it? If it can be shown that with waters such as above a further reduction after filtration of another 99 per cent. can be made, leaving 50 bacteria per c.c., then sterilization will prove a most useful adjunct to filtration, more especially for such waters which are known to be sewage contaminated, and contain an abnormal high bacterial count to begin with.

The fact that large sums of money are being spent in Europe in adding sterilizing plants to the present filtration systems proves that the problem has become more real than any dream, and it cannot be dismissed from the question of water purification by any such offhand statement.

## CHEMISTRY AND SEWAGE PURIFICATION.

In this issue we publish a paper read before the British Society of Engineers upon the above subject. Dr. Sommerville, the author, is lecturer in King's College, and is an authority upon whom we may depend for any chemical explanations of the various processes which sewage undergoes in its transformation from the organic to the inorganic.

It is interesting to note that his conclusions are in general agreement with those of the German chemists. He holds and agrees with Dr. Dunbar, of Hamburg, that the fermentation processes which occur in sewage are mainly due to enzymes. Some of Dr. Sommerville's practical conclusions will be read with interest by engineers, especially those dealing with so-called anaerobic action or septic treatment. He considers that "aerobic action has the best of it all the way round." "It was possible to construct a septic tank installation on a small scale where all might go well for a number of years, but large installations without exception failed."

We cannot agree with the author's remark, that "sewage purification was from first to last a matter of biological chemistry committed to the **tender mercies of the engineer.**" After all, the engineer has been the pioneer in this particular work, and although his attempts may have rested upon empirical bases, the bacteriologist has simply come along and explained and defined results. Sewage disposal and especially the question of removal of solids is largely a question of mechanics and hydraulics. The flow of liquid, its distribution by sprinklers or other mechanical methods ae entirely engineering questions. We are content that the chemist and bacteriologist take their part in the problem, and are sure that much is to be learned by the engineer from their collaboration; but, we are not content that the chemist shall claim that the whole question is entirely one of chemistry.

## CHEMISTRY AND BACTERIOLOGY OF SEWAGE PURIFICATION.

At a meeting of the Society of Engineers held on Friday at Caxton Hall, Dr. David Sommerville, of King's College, lectured on the above subject.

Dr. Sommerville prefaced his paper by saying that in no field of applied science is the need of research more pressing than in that of the purification of sewage. Sewage purification was from first to last a matter of biological chemistry committed to the tender mercies of the engineer. In this work chemistry and bacteriology could not be separated. The intention of the paper was to refer engineers to some fundamental principles connected with the purification of sewage. The author showed that bacterial action was effected through enzymes. The cell consists of colloids and crystalloids in common solution in water, and all cellular reactions are reactions in solution, and based on laws governing their velocities and the conditions of equilibrium. The living cell was an energy transformer, and in all its activities conforms to the requirements of the doctrines of the conservation of matter and of energy.

Enzymes were catalysts, and under their influence it could be shown that for a single substance $\alpha$ undergoing conversion into two substances $\beta$ and $\gamma$, the common type of action of enzymes,

$$\frac{dx}{dt} = k(\alpha - x) - k_1(\beta + x)(\gamma + x)$$

where $\alpha$ is the molecular concentration of the single substance, $\beta$ and $\gamma$ molecular concentrations of the two into which it is converted, and x the change in concentration in time t. Enzymes, unlike inorganic catalysts, were rendered inactive by rise of temperature. Enzymes were colloids, and as such subject to the laws governing the phenomena known as "absorption." Enzymes were capable of reversible action, and consequently effected syntheses as well as dissociations. Sewage was composed of a watery mixture of proteins, carbohydrates, fats, and various inorganic matters. The organic matters existed in solution and in particulate form. Colloidal solutions were constantly encountered. Sewage was charged with bacteria and enzymes and when of domestic type contained, in addition to air, water, and soil organisms, dominant types indigenous to the human intestine.

Where population was sparse the disposal of human excreta was a matter of little difficulty, for the soil received them and dealt with them effectively. In point of efficiency, no artificial method could compare with this natural one, and all that was required was to commit the materials to earth at a safe distance from the dwelling and from watercourses. Sewage carried the organisms and enzymes of its own putrefaction. The chemical reactions of the putrefactive stage were closely analogous to those which effected the digestion of food-stuffs in animals. Protein dissociation occurred in two secondary—amino acids. Dr. Sommerville referred to the constitutional structure of a few of the more commonly occurring amino acids, and said the hydrolysis of carbohydrates and fats was simple when compared with that of proteins. Most species of bacteria in sewage and soil were capable of forming ammonia from organic matter. Free nitrogen was liberated by some sewage bacteria and atmospheric nitrogen fixed by others. Certain bacteria reduced nitrates to nitrites and ammonia; others reduced nitrates and nitrites to NO and $N_2O$. Where unlimited oxygen was supplied nitrification predominated, but where oxygen was limited denitrification appeared. In certain cases it might be advantageous to transform as much as possible of the nitrates and ammonia into free nitrogen. The presence of humus in soil added to its nitrifying power, and beds performing nitrification poorly might have their activity increased by the addition of humus from other beds working normally. Experiments carried out at Kingston-on-Thames in 1907 of seeding nitrifying beds doing poor work with humus from other beds working normally, showed that the purification was in all cases increased. From these results it would appear that there are conditions in which increased nitrification went hard with land with increased ammonia formation, and one must be careful not to dogmatize or draw a priori conclusions as to what might or might not take place in the as yet unknown complexities of the sewage bed. Inasmuch as it required weeks or months to transform dead proteins in the soil into nitric acid it was useless to conclude that in a filter bed of whatever type wherein the opportunities of nitrification were often no better than, if as good as, that in the soil, masses of particulate nitrogenous matter were dissociated and completely oxidised in a few hours. In the nature of things this could not be. It was true that the effluent for such a bed was in physical characters very different from the sewage that entered the bed, but it was not true even in the case of the most efficient bed that the matters with which the effluent had parted had been fully or even partially oxidised. It was possible in five minutes to transform the foulest sewage into a passable effluent by two or three filtrations through animal charcoal, but the charcoal at the end of a month would still contain undissociated proteins, which at the end of the second month would not have reached the stage of nitrification. In phasic enzymic action, where it was desired to maintain activity continuously, it was import-

ant that the products of the end reactions be removed as rapidly as they were formed. Otherwise the equilibrium point must sooner or later be reached, and the date at which it was reached would depend mainly on the rate of their removal. This was the rock on which all artificial filters split—some sooner, some later. In anaërobic tanks certain foul-smelling gases were needlessly set free. In the presence of oxygen entirely different types of cleavage products were formed whose sulphur was ultimately oxidised in the most unobjectionable manner. There was no necessity to use noxious methods of protein cleavage when innocuous methods were at hand, and he considered that the aërobic method of treating sewage had the best of it all the way round. It was possible to construct a septic tank installation on a small scale where all might go well for a number of years, but large installations without exception failed. The time for these to reach the equilibrium point was only a detail. Proceeding to discuss the question of what was a safe sewage effluent and how it was to be produced, Dr. Sommerville said the Royal Commission had been considering those questions for eleven years and he might be pardoned if, like those gentlemen, he hesitated to make a categorical reply. No standard would ever be possible if all cases of each effluent must be produced with direct reference to the conditions of its district. Into streams from which drinking water was drawn no effluent which contained bacteria capable of producing disease should be allowed to enter. In the light of present knowledge it would seem that biological chemistry now afforded sufficient machinery in the form of methods to carry many problems of sewage purification several steps nearer solution, such as the determination of (1) the action on bacteria of intermediate and late products of dissociation of proteins, (2) the origin and methods of isolation of those enzymes which most rapidly and completely disintegrate proteins, carbohydrates, and fats, (3) the amount of absorption effected by different types of filtering material encountering different types of sewage, (4) the concentration of the substrata in the filtering medium which admits of the greatest enzymic change, (5) the influence of temperature on the dissociation and nitrifying processes (6) the duration in point of time of both sets of processes and of their individual phases, and (7) the exact chemical and physical conditions which sustain the life and produce the death of the pathogenic bacteria of sewage and of sewage effluents. Here was work for another Sewage Commission.

## THE PURIFICATION OF SEWAGE.*

### Interesting Results have been obtained at the Sanitary Research Laboratory in Co-operation with the United States Geological Survey.

The problem of purifying sewage so that it no longer transforms the rivers into which it is discharged into open sewers has been so far solved that these streams need no longer be disgusting to the senses and dangerous to the health of people living along them. The task of destroying the disease-breeding bacteria in the sewage and once more making the rivers available for drinking water has not yet been worked out on a practical basis, but investigations recently made by the United States Geological Survey in co-operation with the Sanitary Research Laboratory of the Massachusetts Institute of Technology and local authorities at Boston, at Baltimore, and at Red Bank, N.J., show that this end, too, may be attained at a reasonable cost.

A recent bulletin of the United States Geological Survey says that the essential agents of sewage purification are provided and employed by nature, and sewage purification as practised to-day is but the intensive application of these natural processes. The improvements that have been made have not involved the discovery or application of new principles, but have merely increased the working efficiency of the natural agencies. From the old time sewage irrigation field, with its practical capacity of possibly 10,000 gallons an acre in twenty-four hours, to the present day trickling filter capable of dealing with 2,000,000 or 3,000,000 gallons an acre a day, improvement has been steady.

The old time methods, however, really destroyed the polluting substances, while the modern sewage filter does not. The liquid flowing from these filters looks to the untrained eye like the original sewage. There is almost as much organic matter in it as in the raw sewage, and sometimes more. Its nature, however, has been changed; the organic matter, though not burned up, has been charred or partly oxidized, and this charring has been sufficient to rob it of its foulness. In other words, its chemical composition has been so altered that it can no longer undergo rapid putrefaction and cause a nuisance.

The water, however, still needs filtration to make it fit to drink. Moreover, it may, and in many cases does, contaminate oyster beds, thus spreading disease and tending to ruin a great industry.

It has not yet been decided upon whom the responsibility rests for keeping the rivers clean, but the consensus of competent opinion requires that, if sewage is discharged within the region of important shellfish beds or into a stream which is used as a source of domestic water supply without filtration, such sewage shall at least be free from disease-breeding germs.

The Geological Survey experiments, which are set forth by Earle B. Phelps ('09), in Water-supply Paper 229, just issued, show that the application of a small amount of available chlorine in the form of bleaching powder to the customary "purified" sewage effects satisfactory disinfection. The removal of bacteria by this means averages over 95 per cent., making the removal for the whole purification process 98 to 99 per cent. of the number in the crude sewage. The cost of disinfection ranges from $1 to $1.50 per million gallons of sewage, depending chiefly on the size of the plant. Five parts per million of chlorine probably represents the maximum amount required for the treatment of trickling-filter effluents of poorer quality. The results obtained with the amounts of disinfectant specified do not, of course, amount to complete sterilization, but they may reasonably be called "practical disinfection." Considerable additional cost is required to improve them but slightly

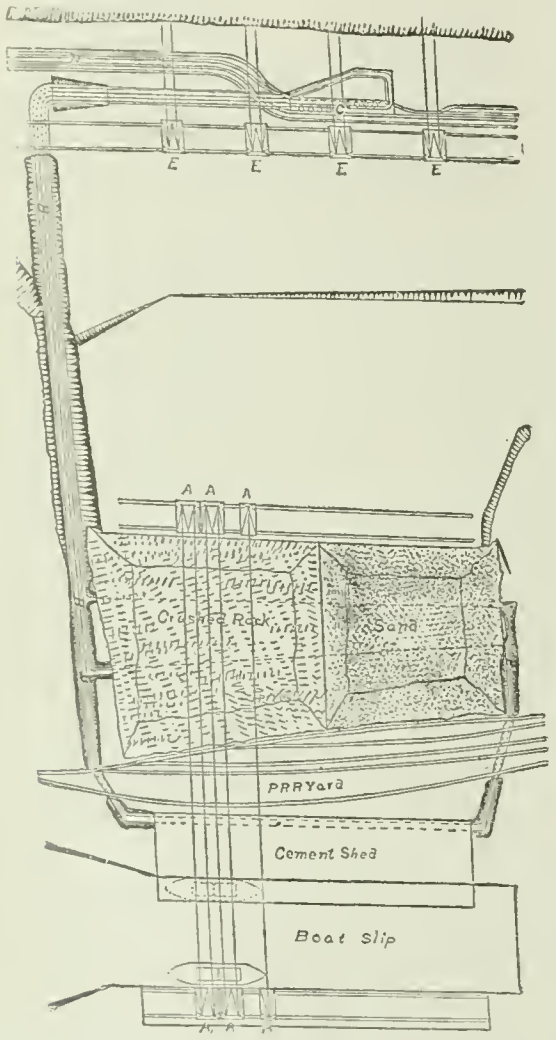
*From the Technology Review.

## THE LAST STAGE IN THE CONSTRUCTION OF THE PANAMA CANAL.

The building of the Panama Canal is now in its fourth and final stage. The first stage was the sanitation of the canal zone; the second, the re-building of the Panama Railroad so as to supply facilities for transporting the spoil from the excavations to the dumps; the third, the excavation of the canal, the fourth, and last stage, the building of the Gatun dam and locks, and the locks at Miraflores and San Miguel. On August 1st of this year, the excavation (182,000-

600 cubic yards, of which 40,000,000 cubic yards available had been done by the French) had advanced to a point where only 101,000,000 cubic yards remained to be done, which, as officially stated by Col. Goethals, can be finished by August 1st, 1911. The remaining excavation is proceeding at the rate of about 3,000,000 cubic yards per month.

Keeping pace with the speed of excavation are the construction operations in connection with the Gatun dam and locks. A most important part of the mechanical equipment are the 13 Lidgerwood high speed cableways which were especially designed and installed for building the Gatun locks. Upon 5 of these, known as the unloader cableways,




**Plan of the cableways showing their relationship to the branch of the old French Canal where the barges arrive, the cement shed, the storage yard, and the automatic railways.**

will fall the brunt of the work, and upon the ability of these 5 to handle the amount guaranteed, or more, must depend the question of whether the canal will be finished and in operation on January 1st, 1915, or earlier. These cableways have exceeded their guaranteed capacity by such a large percentage that the engineers in charge of this section of the work are confident that it can be finished at a much earlier date. They are recognized unofficially by Col. Goethals as "the big crowd."

The work of these 5 cableways is to handle the broken stone and sand which will be required for the walls and floors of the locks. There are 6 locks, each 1,000 feet long in the clear of 110 feet wide. They lie side by side in flights of three, making a total length of more than 3,000 feet. Together they provide a total lift of 85 feet with some to spare for changes in the initial water level. In these locks there will be used 2,000,000 cubic yards of broken stone, 1,000,000 cubic yards of sand, and 2,200,000 barrels of cement. The stone and sand arrive in barges on a branch of the old French Canal. The unloader cableway takes it out of the barges with great grab buckets and delivers it 600 feet or more away in heaps in the storage yard. From here it is taken by the cars of an automatically operated electric railway to the mixers and from the mixers the concrete is taken in other electric cars to where the second set of 8 cableways can put it in place in the forms for the walls and floor. Four cableways arranged in pairs on two sets of towers, handle the broken stone and a single cableway with independent towers unloads the sand from the barges and deposits it on a storage pile. Each cableway has a span of 800 feet. In the duplex cableways the cables are 18 feet apart. This corresponds with the distance apart of the transverse bulkheads in the barges. The cableways are all mounted on steel towers 85 feet high. The towers are mounted on trucks and travel on tracks, so that each cableway performs the function of a travelling crane. The unloader cableways travel the length of the storage yard. Those for building the locks travel more than 3,000 feet. They are all moved electrically, each pair in unison. From the carriage of each of the 5 unloader cableways there is suspended an improved special 70 cubic foot iron-ore type of excavating bucket. Each bucket grabs an average load of 54 cubic feet. The load is hoisted 85 feet, conveyed about 600 feet, dumped on the storage pile, and the carriage and bucket returned. This round trip has been made in 1 minute and 8 seconds. The cableways were guaranteed to handle 50 cubic yards an hour each. They have carried 90 cubic yards in an hour and the average operation up-to-date is 60 cubic yards per hour. This ought to be materially increased with practice. The present record is declared to be double that of any cableway previously employed anywhere.

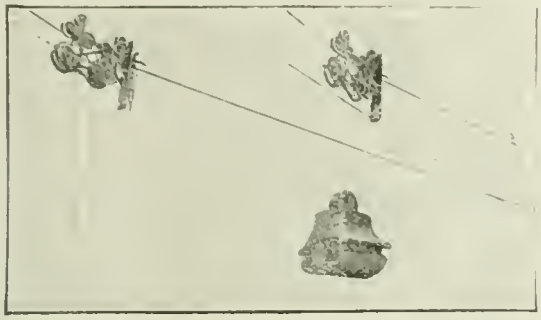
The high speed and consequent increase in the capacity of the cableways is due to the ease with which the operation of the cableways is controlled; the rope-lead that simultaneously raises and traverses the bucket; the high-speed shock-absorber with which the fall-rope carrier is equipped, and a new type of button-stop.

The hoisting and conveying machinery in the head tower is controlled by an operator in the tall tower stationed on an elevated platform commanding a clear view of the bucket at all times and in all positions. He controls two 150-h.p. motors by master controllers of the New York Subway type, and the air brakes by two levers operating magnet valves 800 feet away. The physical effort of operation is so easy that the operator can comfortably maintain the high speed. In all previous cableways this effort was so fatiguing that, although it was possible to attain a speed of 35 round trips per hour with mechanical levers, this could not be sustained for any length of time.

The rope-lead which simultaneously hoists and traverses the bucket causes the latter to move in a curved line corresponding somewhat to the hypothenuse of a triangle, instead of moving on the vertical and horizontal sides. Considerable increase of speed and diminution of travel is thereby effected. The high-speed shock-absorber with which the fall rope carrier is equipped is the invention of Spencer Miller. It permits the carriage to travel at the unusual speed of 2,500 feet per minute, more than double the speed of any previous

cableway. The button-stop employed has been successfully tested experimentally with a fall-rope carrier running at the speed of 3,000 feet per minute.

On account of the ease of operation of these cableways, considerable difficulty has been experienced in restraining the operators from racing with each other. The cableways have frequently been operated at a speed of 3,000 feet per minute, which, being at present too severe for the fall-rope carriers, is now limited to 2,500 feet per minute. Some of the



**Another view of the carriage and buckets, showing also the fall-rope carriers.**

small pieces forming the heads of the fall-rope carriers are being replaced with heavier pieces which, it is believed, will admit of even the higher speed.

Another feature of these cableways which is new is that the bucket is counter-balanced like a passage elevator. Thus only the net load has to be hoisted and only enough power is required to do this and overcome friction and inertia.

The eight cableways used for putting the materials in place in the lock walls are similar in span, height, style of towers, and method of control to those for unloading the ma-

**The five high-speed Lidgerwood cableways which are handling, from barges to the storage heaps, the 2,000,000 cu. yards of broken stone and 1,000,000 cu. yards of sand required to build the Gatun locks.**

terials, but they will never be called upon for such rapid work. While they will handle the entire amount of concrete, and besides this, the wooden forms and the many tons of old rails which are to be put into the concrete for reinforcement, there are eight of them as against five of the others, and each will have much less to do. This is necessary as the placing of the concrete requires care and deliberation. The immense quantity of concrete material for the Gatun locks will perhaps be better appreciated if one remembers that handled separately it amounts to more than 3,300,000 cubic yards.

## SOCIETY NOTES.

**Canadian Society of Civil Engineers, Toronto Branch.**—The Toronto members of the Canadian Society of Civil Engineers held their regular monthly meeting on Thursday, November 25th, at the Engineers' Club rooms. Thirty-five members were present, and Mr. C. R. Young, B.A.Sc., introduced a lengthy discussion on "Impact Stresses," a paper by Professor E. A. Stone, Dean of Engineering in the University of New Brunswick at Fredericton. Included in those contributing were Dr. Galbraith, J. G. G. Kerry, F. L. Somerville, Peter Gillespie, Frank Barber, and E. H. Darling, assistant engineer of the Hamilton Bridge Works, whose contribution was read by Mr. Gillespie. Following the discussion, Mr. A. C. D. Blanchard, assistant city engineer, Toronto, presented some interesting views of progress work on the construction of the high level intercepting sewer now being built in Toronto. Mr. J. G. G. Kerry, C.E., presided.

**McGill Applied Science Undergraduates.**—The regular November meeting of the McGill Applied Science Undergraduates Society was held on November 24th, when a most interesting and profitable address was delivered by Mr. M. J. Butler, Deputy Minister of Railways and Canals, who chose as his topic "The Training of an Engineer and the Outlook for an Engineer in the Development of his Country." Mr. Butler emphasized the importance to the student of knowing the elementary mathematical subjects such as arithmetic, geometry, algebra, and trigonometry, and advised them to master principles, not details. In discussing the outlook for an engineer the speaker referred to the possibilities of the Hudson's Bay Railway. The surveys, he said, had been completed, and showed that a splendid line of railway could be secured from The Pas to the Hudson's Bay with a good, low gradient. The line would not be an expensive one to build. In connection with water transportation, Mr. Butler dwelt at some length on the Georgian Bay Canal, and pointed out the difficulties which he thought would be encountered by ocean boats in going through the canal. Dean Adams and other members of the teaching staff, who were present, briefly expressed their appreciation of Mr. Butler's address.

**Union of Manitoba Municipalities.**—The sixth annual convention of the above society was held on Tuesday, Wednesday and Thursday, November 23rd, 24th and 25th at Portage la Prairie. Mr. J. C. Menlove, of Virden, presided, and nearly 200 delegates were present. Resolutions were passed and papers read, including two on Waterworks and Sewage Disposal Systems, by Dr. A. J. Douglas, of Winnipeg, and Mayor Harvey, of Dauphin. Mr. C. H. Dancer read an instructive paper on "Good Roads." The Good Roads Association of Manitoba recommended the appointment of a Government Highway Commissioner. The election of officers resulted as follows: President, Sec.-Treas. Menlove of Virden (re-elected); vice-president, Reeve Forke of Pipestone; sec. treas., Coun. Cardale of Blanchard; executive committee, Reeve Thomson of Assiniboia; Mayor Harvey of Dauphin; Reeve Allan of Odonah; Reeve Willis, Morton; Reeve Poole of Archie; Coun. Thomson of Portage; Cont. Waugh of Winnipeg; solicitor, Mayor Adolph of Brandon.

**American Society Engineering Contractors.** — The first monthly meeting of the above society will be held in the United Engineering Society Building, 25 West 39th Street, New York City, on Wednesday, December 14, 1909, at 8.30 p.m. A paper by Halbert P. Gillette, entitled "The Science of Management Engineering," will be read and discussed.

## RAILWAY ORDERS.

(Continued from Page 623)

8657—November 16th—Granting leave to the East Middlesex Telephone Company, Limited, to erect, place, and maintain its wires across the track of the Grand Trunk Railway on the 6th Concession, Township of Missouri, County of St. Mary's, on its London and St. Mary's branch.

8658 to 8660 Inc.—[illegible] th—Granting leave to the Bell Telephone to erect, place, and maintain its wires across the track of the Grand Trunk Railway at P. C., ½ mile south of Port Robinson Station, Ontario, at P. C. Waterloo Street, New Hamburg, Ontario, and the C. N. O. Railway, at a point three miles south of Joliette, P. Q.

8061—November 16th—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the C. N. Q. Railway, at a point two miles south of Joliette, P. Q.

8062—November 16th—Authorizing the Canadian Pacific Railway to construct, maintain, and operate industrial spur for the Imperial Oil Company, at Red Deer, Alberta.

8063—November 16th—Granting leave to the C. N. Q. Railway to construct its lines and tracks across the public road on Lot 134, Parish of Cap Rouge, east of Cap Rouge River, County of Quebec, mileage 12.08 west from Quebec bridge.

8064—November 16th—Granting leave to the C. N. Q. Railway to construct its lines and tracks across the public road at Cap Rouge Station, on Lot 46, Parish of Cap Rouge, County, Quebec, P. Q., mileage 12.77 west from Quebec bridge.

8065—November 16th—Granting leave to the Board of Light and Heat Commissioners of the city of Guelph, Ont., to erect, place, and maintain electric wires across the track of the Grand Trunk Railway, at Norwich Street, Guelph, Ontario.

8066—November 16th—Authorizing the Canadian Pacific Railway to construct, maintain, and operate an extension of industrial spur at present constructed to the Brandon Brewing Company's plant in the city of Brandon, Manitoba.

8067—November 17th—Approving and sanctioning location of a portion of the Canadian Pacific Railway Company's Langdon branch from mileage 80 to mileage 106.96.

8068—November 17th—Granting leave to the C. N. Q. Railway, to construct its lines and tracks across Little River Road, in Parish of St. Sauveur, County Quebec, P. Q.

8069—November 17th—Authorizing the Brandon, Saskatchewan & Hudson's Bay Railway, to construct, maintain, and operate branch line of railway or spur within city of Brandon, Manitoba, upon 15th Street.

8070—November 17th—Granting leave to the village of Brussels, to erect, place, and maintain its wires across the track of the Grand Trunk Railway, on its London, Huron & Bruce Division, at intersection of Concession line between 5th and 6th Division, Township of Morris, Province Ontario.

8071—November 17th—Granting leave to the village of Brussels, Ontario, to erect, place, and maintain its wires across the track of the Grand Trunk Railway in the Township of Grey, at Ethel Station, at mileage 21.87, from Palmerston, Ontario.

8072 & 8073—November 17th—Granting leave to the Horton & McNab Telephone Company, to erect, place, and maintain its wires across the track of the Grand Trunk Railway, at a point on Lot 22, 7th Concession, Township of McNab, County Renfrew, one mile west of Glasgow Station, Ontario, also at Lot 19, 8th Concession, Township of McNab, County Renfrew, Province Ontario.

8074 to 8076 Inc.—November 17th—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the track of the Grand Trunk Pacific Railway, at point three miles west of Portage la Prairie, Manitoba; the Canadian Northern Railway, 100 yds. east of Rapid City Station, Manitoba, and the Canadian Northern Railway three miles west of Portage la Prairie, Man.

8077 & 8078—November 17th—Granting leave to the Saskatchewan Government Telephones to erect, place, and maintain its wires across the track of the Canadian Northern Railway Company, one sixth of a mile north of Dundurn Station, Saskatchewan, and at Disley, Saskatchewan.

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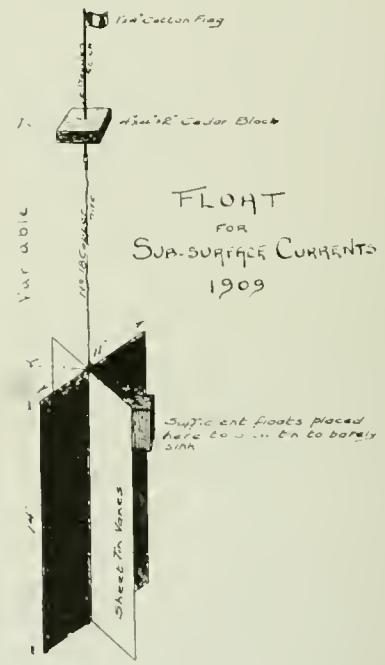
## LAKE CURRENTS NEAR TORONTO.

**F. W. Thorold, B.A.Sc.***

During July, August and September of this year observations were made daily under instructions from Mr C. H. Rust, City Engineer, Toronto, to determine the direction and velocity of the sub-surface currents of Lake Ontario in the vicinity of the outlet from the proposed sewage disposal works.

The disposal works will be situated south of Eastern Avenue, and between Woodward Avenue and the Woodbine race track.

The outlet will be about on the line of Lockwood Road produced south, and 5,200 feet from the tanks, or a distance




of about 3,500 feet out in the lake, in a south-easterly direction from the sandbar.

A number of floats of different shapes and sizes were tried before permanent records were made and the float, if such it may be called, shown was finally adopted.

This float was found to be very satisfactory. Sufficient wood blocks, previously painted, were attached to the tin vane, so that it would barely sink. A small block was put near the surface, and the flag on a small stick at the surface. No observations were taken at a less depth than five feet.

These floats were placed at the proposed end of the sewer outlet each morning from July 10th to September 16th, 1909. The velocity of the wind was taken about four

* Assistant Engineer, Toronto, Ont.

feet above the water with an accurate, tested anemometer, and the direction of the wind with a pocket compass. The wind was taken three times a day. The floats were located at night by means of a sextant. The vanes on the floats were placed 5, 7½, 10, 15, 17½, 20, 25, 27½ and 30 feet from the surface. The place where each float was found was then plotted on a plan and a general study made of the velocity and direction of the wind and the location of the float. With this information on hand it was possible to arrive at some definite conclusions.

From the study of our observations I am satisfied that if Lake Ontario had no inlet or outlet and was placed so that no wind would ever touch its surface, there would be no current outside of that caused by changes in temperature, and our floats would remain where they were placed.

If, however, an inlet and an outlet were introduced, the general movement of the water would be towards the outlet. There might, of course, be slight back currents along the sides and bottom caused by projections, etc.

We found that in Lake Ontario, at the end of the sewer outlet, when htere was no wind and the previous day had been calm, our floats were invariably carried east.

On July 19th the wind blew from the north and north-west from 5 to 20 miles an hour. On July 20th it blew from 0 to 4.9 miles an hour from the south-west and south, and on the 21st it blew from 2 to 6.5 miles from the east. On the night of the 21st, with an east wind blowing, our floats were found east of the buoy (sewer outlet). This would show that either the current was naturally to the east, or that the winds on the 19th and 20th had caused the current to be easterly.

On the 20th, with the south-west wind, our floats were found east of the buoy, where we would expect to find them, whether there was a natural easterly current or not.

On the 22nd, with an east and south-east wind, about seven miles an hour, our floats were west of the buoy.

In each case the deep float was nearest the buoy, and the shallow float furthest away, with the others between these.

On the 24th the wind was from the north-west at 17 miles an hour; still the floats went slightly west (400 feet), caused by the wind of the three days previous.

It should be stated here that we very seldom found a float grounded. If the wind was towards shore, our floats tended to go parallel with the shore. This will be mentioned later.

A 4-mile south-west wind on the 26th took the 17½-foot float 4,600 feet and the 5-foot float 8,300 feet east of the buoy.

On August 4th the wind was from the south and east, 5 to 7 miles, and on the 5th, 3 to 11 miles from the east, while on the 6th it was 4 to 7 from the south-west; still, our deep floats on the 6th went west and south again, showing that the wind of the previous days had created a sub-surface current to the west. The shallow floats went due south on this day.

On August 5th, with a 3 to 11-mile east wind, and the south and east wind of the 4th, the floats were west of the buoy, the 27½ feet being closest and the shallowest float furthest away. This again shows wind of previous days and August 4th drove all floats west

A 7-mile south-west wind on the 8th, with an 8 to 18 west wind on the 9th, sent the floats east, the 7½-foot float being 8,000 feet and the 22½-foot float 1,200 feet from the buoy. West winds of August 9th and 10th took the deep floats of the 11th a mile east, although there was a 10-mile south-east wind blowing. In this case the 7½-foot float which went north-west, was acted on by the wind, and the 26-foot float by the current caused by the previous three days' west winds.

On August 10th, with a 10-mile west wind (shifting to a 15-mile north-east wind) and three days' previous west wind, the 5-foot float followed the north-east wind 10,600 feet out into the lake, while the 27½-foot float went only 4,900 feet from the buoy, and south-south-west. Evidently the 27½-foot float was caught where the two currents met, and as a consequence was carried south.

The wind on the 11th, 12th, 13th, and 14th, was from the east, 7 to 23.7 miles per hour, and the floats of the 14th all kept within 300 feet of each other, and went south-west from the buoy 3,800 feet. The floats on this day were 5, 7½, 15, 17½, 25 and 27½ feet deep, so that the current was practically equal at all depths this day. A straight east wind (and the wind was such) should have driven them to shore, but they went south-west, or tended to run parallel with the shore.

On the 13th, with two days' continuous due east wind, the shallow floats went west, while the deeper floats went south of south-west. On this day the 27½-foot float went further than the shallower floats. A distinct distance was noticeable between the 5 to 12-foot floats and the 15 to 27½-foot floats. The former apparently went with the wind, while the latter went out into the lake. This day the 27½-foot float went 7,500 feet south-west, and was about on the line of Leslie Street produced.

On September 1st, with an 18-mile north-west wind, the floats went 8,700 feet south-south-east of the buoy and out in the lake on the line of Woodbine Avenue produced. The wind on August 30th was 8 to 11 miles south, and on the 31st, 3 to 14 miles south-west.

On September 2nd the wind blew from a westerly direction, 10 to 12 miles an hour, and our floats were found about 5 miles east and ½ mile from shore, opposite Scarboro' Bluffs.

Numerous other examples might be given, but space will not permit.

By making a study of all the data the following conclusions have been drawn:—

(1) With no wind there is a gradual movement of the water towards the east.

(2) There is practically no regular current in Lake Ontario in any particular direction.

(3) Currents are formed in the vicinity of the outlet by the action of the wind only, and their velocity increases inversely as the depth.

(4) The surface water moves in the direction of the wind, but when within two or three thousand feet of shore it tends to run parallel with the shore in either direction, depending entirely on the direction of the wind at the time: but this current has not sufficient velocity to transport sand.

(5) The sub-surface water is not affected as rapidly as the surface, and may continue to move in one direction for hours after the wind has blown in that direction and at the same time as the surface water is moving in the opposite direction.

There is a current along shore caused by the wind directly, and indirectly by the wind through the waves, the direction of this current depending upon the direction of the wind.

The one prominent point of these conclusions is that the wind governs the current.

The writer does not like the word "current" to describe the gradual easterly movement of the water in calm weather

There is, however, a noticeable current during storms or winds.

Before discussing the velocity of the wind and currents a short description of the sewer outlet might be here given.

The end of the outlet from the sewage disposal tanks will be 3,500 feet from the lake shore and at about right angles to the shore. The pipe will be of steel, 60 inches in diameter, having the last 500 feet (outer end) tapered from 60 inches to 24 inches diameter. This tapered end will have 120 holes, 4 inches diameter, spaced about 4 ft. 2 in. apart, so that it will be in the form of a huge submerged spray. The effluent will have a velocity of from 2 to 7 feet per second in the pipe, depending on the elevation of the surface of the water of the lake.

During low water the velocity in the pipe will be greatest, so that the effluent will be spread out over a large area, while during high water, while there is less velocity in the pipe, the discharge takes place in deeper water.

The outlet will be in 29 feet of water at average lake level, and the holes are on each side of the pipe and end.

The specific gravity of the effluent will be about 1.002. The velocity of the sewage in the tanks will be so reduced that practically no solids will reach the outlet.

During calm weather this large body of greatly diluted effluent will be carried east. During continued winds from any direction it will be carried in that direction. It will keep rising to the surface, and constantly be changing its velocity and direction, thus becoming more diluted. It will be tossed about by the waves and oxidized: if there are no waves, and necessarily no wind, it will drift east. If it is washed into shore to the west of the outlet, it will be because of east winds and on account of the great sweep of these winds up the lake. The greatest waves are from the east, so that the greatest oxidation will take place during these winds.

However, a large part of the diluted effluent may remain below the influence of the waves and be carried by the current.

The greatest current we found from the east was at a depth of 5 feet, and was the rate of 0.35 miles per hour. At the same time as we had this current at a depth of 5 feet we found only 0.12 miles per hour at a depth of 27 feet. This was caused by a blow of four days' duration from the east. The greatest current in any direction that we found at a depth of 27 feet was at the rate of 0.28 miles per hour towards the east.

The accompanying table gives a record of the winds as recorded at the Toronto Observatory from June 1st, 1908, to September 31st, 1909.

When a wind is given as east or west it is understood to be from an easterly or westerly direction.

The only winds which would cause the current to pass from the sewer outlet to the waterworks intake would be from the east or north-east, but as we have not separated these we will assume all easterly winds blow towards the intake.

We find there were 31.1 per cent. of the winds from this direction in 485 days, while 69.9 per cent. of the winds were from other directions.

On account of the nature of the outlet; the variable winds and variable currents caused by them; the fact that the wind does not blow in any one direction for any great length of time; and of the further fact that the general movement of the whole mass of water is to the east, I am forced to believe that the effluent will be perfectly diffused and carried away without harm to the city of Toronto or any neighboring towns further east.

Before concluding, I would like to make a few remarks about the "theories" of Lake Ontario currents we so often hear or read about.

It is a settled fact in the minds of a number of people that the waters of the Niagara River run straight for Toronto, and maintain their velocity throughout the thirty-four miles. For some reason this current is split up and causes shore currents, one of which runs from east to west from near the proposed sewer outlet towards the waterworks intake. I have been unable to find from what source this information has been gathered, because no observations of such a current have been made.

The waters of the Niagara River entering Lake Ontario at Niagara would have about as much influence on the lake current at Toronto as a garden hose discharging into Toronto Bay at Yonge Street would have on the current of the water at Centre Island.

The mean velocity of the Niagara at Lewiston is 3.12 feet per second, and less at Niagara. At a distance of 2.8 miles from the mouth of the Niagara shoals are formed, because the current has been so diminished that it cannot transport sand. This means that in a distance of, say, three miles, the current has been reduced to about one foot per second, so that the remaining velocity would be lost completely in another half mile. The slightest wind blowing

1909

| JAN. | | | | FEB. | | | | MAR. | | | | APRIL | | | | MAY | | | |
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| 7 | 2 | 4 | 18 | 3 | 0 | 5 | 18 | 11 | 1 | 6 | 11 | 4 | 2 | 11 | 8 | 1 | 2 | 12 | 11 |
| | | | | 2 Variable | | | | 2 Variable | | | | 3 Variable | | | | 5 Variable | | | |
| JUNE | | | | JULY | | | | AUG. | | | | SEPT. | | | | OCT. | | | |
| N | S | E | W | N | S | E | W | N | S | E | W | N | S | E | W | N | S | E | W |
| 0 | 0 | 10 | 16 | 1 | 0 | 10 | 18 | 1 | 0 | 12 | 15 | 1 | 0 | 11 | 13 | | | | |
| 4 Variable | | | | 2 Variable | | | | 3 Variable | | | | 3 Variable | | | | | | | |

RECORDS OF WINDS OBTAINED FROM THE OBSERVATORY

1908

| JUNE | | | | JULY | | | | AUG | | | | SEPT. | | | | OCT. | | | | NOV. | | | | DEC. | | | |
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| 2 | 12 | 15 | 1 | 0 | 1 | 11 | 19 | 2 | 0 | 10 | 16 | 0 | 0 | 14 | 13 | 1 | 0 | 2 | 15 | 0 | 0 | 6 | 24 | 3 | 0 | 2 | 19 |
| | | | | | | | | 2 Variable | | | | 2 Variable | | | | 3 Variable | | | | | | | | 1 Variable | | | |

**SUMMARY.**

Out of 485 Days 7.6 per cent. of Winds were from North.
" " " " 3.1 " " " " " South.
" " " " 31.1 " " " " " East.
" " " " 50.5 " " " " " West.
" " " " 6.7 " " " " " Variable.

continuously for three or four days would produce a current more than the Niagara at a distance of three miles from shore. I am, therefore, at a loss to see how the Niagara can affect the current of the lake at Toronto.

One convincing proof often given of this westerly "current" at Toronto is the fact that more sand, clay, gravel, and even **boulders,** are always found on the easterly side of all the piers and jetties in the lake near Toronto than on the westerly side. Even Scarboro' Bluffs are being eroded and transported to the west by this "current."

It is a fact that this material is being moved westerly, but it is not caused by the currents produced by Niagara. Toronto is near the westerly end of Lake Ontario. A due east wind sweeps up the entire lake towards Toronto, and it is on account of this long sweep of the wind, and consequently the large waves, that local currents are produced

along the shore, and the material, even boulders, are moved in a zigzag path towards the west. We never get waves from the west which are nearly as high as those from the east, consequently the net result of the wave action is a movement of solid material along the shore towards the west. The influence of this current is not noticeable, as far as its sand-transporting power is concerned, for more than a few hundred feet from shore.

Nothing has been said about the opinion of the fishermen along the shores, but it has been repeatedly noticed that the nets are set to suit an easterly movement of the water. As a matter of fact, all the fishermen say there generally is a current towards the east.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from Page 617)

**Copies of these orders may be secured from the Canadian Engineer for a small fee.**

8616—November 8—Authorizing the C.P.R. to construct, maintain and operate an additional line of railway across Park Avenue, town of St. Louis, P.Q.

8617—November 5—Authorizing the C.P.R. to construct, maintain and operate an industrial spur for the Massey-Harris Company, Ltd., for the Turpin Fur Company in City of Lethbridge, Alta.

8618—November 11—Granting leave to the C.N.Q. Ry. to construct its lines and tracks across public road in R. 3, Par. Ste. Julienne, P.Q.

8619—November 11—Granting leave to the C.N.Q. Ry. to construct its lines and tracks across P.C. in Parish St. Jacques, P.Q.

8620—November 8—Dismissing complaint of Louis Vallee, Ernest Belisle, and Cotave Courchesne, of La Baie du Febvre, P.Q., against condition of railway crossings of Province of Quebec, Montreal and So. Ry.

8621—November 8th—Dismissing application of the C. N. Q. Railway, for leave to construct its railway across highways in the Parish of Beauport, Co. of Quebec, P. Q.

8622—November 10th—Granting leave to the Tilbury Telephone Company, Limited, to erect, place, and maintain its wires across the track of the M.C.R.R. at P. C., 2½ miles easy of Tilbury, Station, Ontario.

8623—November 10th—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the track of the C. P. Railway, between Sections 3 and 4, Township 46, R. 18, west 4th Meridian, near Bawlf Station, Alberta.

8624—November 3rd—Granting leave to the C. N. Q. Railway, to open for the carriage of traffic portion of its line of railway from St. Jacques to the junction with its line of railway near Dugas, P. Q.

8625—November 8th—Dismissing complaint of Ernest Lyster, of Gore Station, P. Q., complaining of the unsatisfactory and dangerous train service furnished by the G. T. Railway, at Gore, P. Q.

8626—November 8th—Dismissing complaint of the Dominion Park Co., Ltd., Montreal, alleging excessive rates charged by the Bell Telephone Company for the use of telephones at Dominion Park, Montreal.

8627—October 21st—Authorizing the G. T. Railway to expropriate certain lands in the city of Guelph, Ontario, upon which to provide a proper passenger station.

8628—November 5th—Authorizing the town of Palmerston, Ontario, to construct a drain or ditch, under the tracks of the G. T. Railway, at one mile post on its Kincardine branch.

8629—November 10th—Authorizing the C. P. Railway, to construct, maintain, and operate branch line of railway for Lombard Bros. & Marshall, near Milan Station, P. Q.

8630—November 11th—Granting leave to the Saskatchewan Government to erect, place, and maintain its wires across the track of the C. P. Railway, at Estevan, Sask.

8631—November 10th—Ordering that the Grand Trunk Railway shall not be entitled to make any extra charge for the switching performed by it at the spur to the premises of Christie-Henderson & Company, at Hespeler and the city of Guelph, Ontario.

8632—November 15th—Authorizing the Municipal Corporation of the town of Hanover, Ontario, to lay and thereafter maintain an extension of its present water main from Proctor Street, across portion of the yard of the Grand Trunk Railway, to connect with the present main running across said yard.

8633—November 15th—Authorizing the Corporation of the city of Toronto, Ontario, to construct a sewer on Davenport Road, under tracks of Canadian Pacific Railway, said city.

8634—November 15th—Authorizing Henri Cauchon, of Beauport, P. Q., to construct and thereafter maintain drain pipe and water pipe across the property of the Quebec Railway Light & Power Company, at Beauport, P. Q.

8635—November 15th—Granting leave to the Board of Light and Heat Commissioners of Guelph, Ontario, to erect, place, and maintain its electric wires across the track of the Grand Trunk Railway, where the same intersects the roadway known as Duke Street, in said city.

8636—November 11th—Directing the Grand Trunk Railway to provide and construct a suitable interswitching in the town of Brampton, Ontario.

8637—November 12th—Approving interlocking plant of the Michigan Central Railway, to be installed at the east end of its Windsor Yard, Windsor, Ontario.

8638—November 12th—Granting leave to the Grand Trunk Railway to connect its line of railway with the tracks of the Niagara Peninsula Railway Company, in Lot 31, Concession 1, Township of Humberstone, County of Welland, Ontario.

8639—November 12th—Granting leave to the Grand Trunk Railway, to join its tracks with the tracks of the C. N. Q. Railway, in the town of Hawkesbury, Ontario.

8640—November 12th—Authorizing the Grand Trunk Railway to construct an iron foot-bridge for pedestrians over its railway, where the same crosses Metcalfe Street, Guelph, Ontario.

8641—November 15th—Authorizing Cie Fenciere Suburbaine de Montreal, P. Q., to construct and thereafter maintain sewer under the track of the Canadian Northern Quebec Railway, at Long Point, County Hochelaga, P. Q.

8642—November 16th—Granting leave to the Board of Light and Heat Commissioners of Guelph, Ontario, to erect, place, and maintain its electric light wires across the track of the Grand Trunk Railway, where the same intersects the roadway known as Huskisson Street, Guelph, Ontario.

8643—November 16th—Approving and sanctioning location of the Canadian Northern Railway Company's line of railway through Township 5, R. 6, west of the 2nd Meridian, Province Saskatchewan, mileage 65.16 to 70.29.

8644—November 16th—Granting leave to the Canadian Pacific Railway, to divert the road allowance between S. W. ¼ of Section 23, and S. E. ¼ of Section 22, near Exshaw Station, Alberta.

## PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

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This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

Fig. 81 represents an ordinary bell crank.

**If a force P of 100 pounds be exerted at the joint of the upper arm as indicated, what force S must be exerted at the joint of the other arm in order to preserve equilibrium?**

Consider the crank as the body acted upon. The forces acting on this body are P, S, and the reaction Q of the pin on the crank, and for this problem P and S will be considered as acting perpendicularly to the arms of the crank. Since these forces are in equilibrium, their

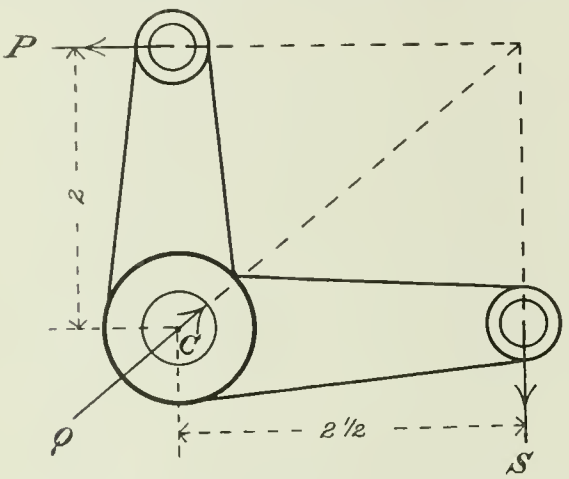


Fig. 81.

lines of action must intersect at a common point as indicated. (Three forces in equilibrium must act at a point.) These forces being in equilibrium, $\Sigma M = 0$.

Take moments about the point C, the centre of rotation of the crank.

$$\Sigma M = M_P + M_Q + M_S = 0.$$
$$-P.\,2 + Q.\,0 + S.\,2\tfrac{1}{2} = 0.$$

Putting in the value of P = 100, we get:

$$-100 \times 2 + 0 + 2\tfrac{1}{2}.\,S = 0.$$
$$S = 80.$$

The positive result shows that the Ms about C is positive; i.e., S acts as indicted on the diagram.

Now, although S is the force which must act with P and Q to give equilibrium, it must be clearly understood that if a force P be exerted at one end of the crank as shown, that **the crank** will exert at the other end a force **equal but opposite to S** on any body to which it may be fastened. The body in resisting this will exert the force S as shown.

**To Find the Reaction Q:—**

Apply either the equation $\Sigma X = 0$ or $\Sigma Y = 0$ to the set of forces P, Q, and S. The value of the sine or cosine of the angle of inclination of Q may be found from the given distances of P and S from C, these distances forming the sides of a right angled triangle, one angle of which is the required inclination. If the hypotenuse of this triangle be calculated, the required sine or cosine may be obtained.

**King Post Truss.**

Fig. 82 represents a simple form of roof or bridge truss, known as a King Post Truss. It must be clearly understood, however, that the ordinary forms of roof bracing, consisting of the rafters and scantling tie-rods, which resemble the above truss in outline, do not really present the same problem as will be herein discussed. Usually, the rafters have the roof sheeting, shingles, etc., lying directly on them over their entire length. In

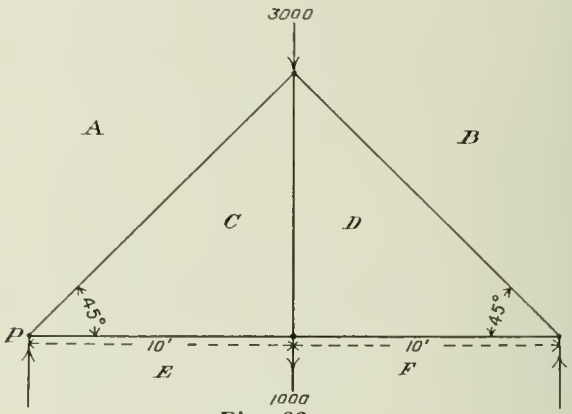


Fig. 82.

this case, these rafters are inclined beams supporting a distributed load, and the stress in them will not be simple Compression, but a combination of both Tension and Compression due to bending. If, however, stringers or purlins be laid from truss to truss on the roofing system so as to lie at the joints of the trusses, or nearly so, and if the rafters and roofing be built on these stringers, the load will then be transferred to the truss merely at the joints, and the case may then be worked out by the methods taken up so far. Fig. 82 A

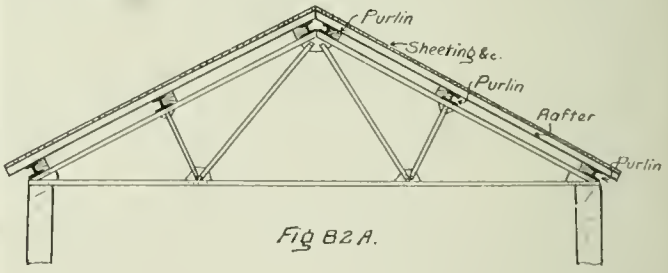


Fig 82 A.

illustrates, for another form of roof truss, the method of laying down purlins and building on them.

There is also a form of bridge truss very commonly met with on country roads which is sometimes called a King Post Truss. The structure referred to has a heavy timber beam laid between the abutments, and the trussing above merely serves to stiffen this beam. In this case, the beam, which seemingly corresponds to the horizontal tie-rod of the ordinary King Post Truss, is not in simple Tension, but has both Tension and Compression existing in it, and these stresses cannot be found by elementary methods.

**Required to find the stress in the members of the truss (Fig. 82).**

**Analytical Solution:—**

The whole truss is a body acted upon by a set of outside forces. These forces, the two loads AB and EF,

and the two abutment reactions BF and EA, are in equilibrium; therefore, $\Sigma X = 0$; $\Sigma Y = 0$; $\Sigma M = 0$.

Take moments about a point in the line of action of one of the abutment reactions, say, the point P.

$$\Sigma M = M_{AB} + M_{EF} + M_{BF} + M_{EA} = 0.$$

Since BF is unknown, assume $M_{BF}$ positive.

$$3{,}000 \times 10 + 1{,}000 \times 10 + BF \times 20 + EA \times 0 = 0.$$

$$BF = -2{,}000.$$

From the negative sign of the result, it is seen that $M_{BF}$ about P is negative; i.e., BF acts upward.

$$\Sigma Y = Y_{AB} + Y_{EF} + Y_{BF} + Y_{EA} = 0.$$

$$-3{,}000 - 1{,}000 + 2{,}000 + EA = 0.$$

$$EA = 2{,}000.$$

From the positive result we infer that $Y_{EA}$ is positive; i.e., EA acts upward.

Consider the forces acting on the pin at the point EAC. The known and unknown forces are represented in the Statical Diagram (Fig. 83).

$$\Sigma Y = Y_{EA} + Y_{AC} + Y_{CE} = 0.$$

$$EA + AC \sin 45^\circ + 0 = 0.$$

$$2{,}000 + AC \cdot \frac{1}{\sqrt{2}} + 0 = 0.$$

$$AC = -2{,}000 \cdot \sqrt{2}.$$

Because of the negative result, the $Y_{AC}$ is evidently

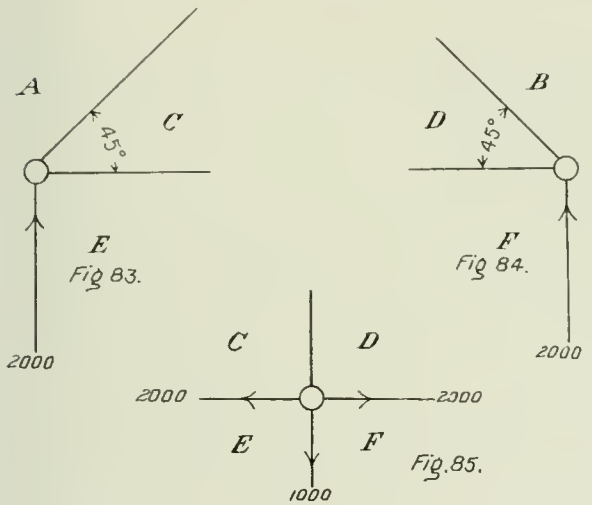


Fig 83.




Fig 84.

Fig. 85.

negative. AC, therefore, acts against the pin; i.e., the member AC is in compression 2,000 $\sqrt{2}$ pounds.

$$\Sigma X = X_{EA} + X_{AC} + X_{CE} = 0.$$

$$0 - AC \sin 45^\circ + CE = 0.$$

$$0 - 2{,}000 \cdot \sqrt{2} \cdot \frac{1}{\sqrt{2}} + CE = 0.$$

$$CE = 2{,}000.$$

The positive result shows that $X_{CE}$ is positive. CE, therefore, acts away from the pin; i.e., the member CE is in tension 2,000 pounds.

Consider the point BFD. The forces acting on the pin are indicated in the Statical Diagram (Fig. 84).

$$\Sigma Y = Y_{BF} + Y_{FD} + Y_{DB} = 0.$$

$$BF + 0 + DB \sin 45^\circ = 0.$$

$$2{,}000 + 0 + DB \cdot \frac{1}{\sqrt{2}} = 0.$$

$$DB = -2{,}000 \cdot \sqrt{2}.$$

From the negative result, the $Y_{DB}$ is seen to be negative. DB, therefore, acts against the pin; i.e., the member DB is in compression 2,000. $\sqrt{2}$ pounds.

$$\Sigma X = Y_{BF} + Y_{FD} + Y_{DB} = 0.$$

$$0 + FD + DB \cos 45 = 0.$$

$$0 + FD + 2{,}000 \cdot \sqrt{2} \cdot \frac{1}{\sqrt{2}} = 0.$$

$$FD = -2{,}000.$$

The $X_{FD}$ is evidently negative. FD, therefore, acts away from the pin; i.e., the member FD is in tension 2,000 pounds.

(The solution for the point EFDC will be given next week.)

## RAILWAY ORDERS.

(Continued from page 621.)

8645—November 16th. Granting leave to the Corporation of the city of Winnipeg, Manitoba, to erect, place, and maintain its electric light wires across the track of the Canadian Pacific Railway, where the same crosses Grey Street, Winnipeg, Manitoba.

8646—November 16th—Granting leave to the St. Maurice Valley Railway Company, to divert slightly the present highway at Station 239-03, and to construct and undergrade crossing at said station at Grand Mere, P. Q.

8647—November 16th—Granting leave to the Nipissing Power Company, to erect, place, and maintain its transmission lines across the track of the Grand Trunk Railway, at highway, at Callander, Ontario.

8648—November 16th—Approving and sanctioning proposed deviation of the Canadian Pacific Railway of its line of railway from mileage 54 to mileage 54.22, Woodstock section.

8649—November 16th—Approving location and detail plans of the Canadian Pacific Railway Company's station, at Midale, Saskatchewan.

8650 to 8652 Inc.—November 16th—Granting leave to the Bell Telephone Company, to erect, place, and maintain its wires across the track of the Canadian Pacific Railway Company's tracks at a point one mile east of Islington Station, Ontario, at P. C. 25 yards east of Islington Station, Ontario, and at Dufferin Street, Toronto, Ontario.

8653—November 16th—Granting leave to the Theodore, Springside and Beaverdale Rural Telephone Company, to erect, place, and maintain its wires across the track of the Canadian Pacific Railway, at Springside, Saskatchewan.

8654—November 16th—Granting leave to the Saskatchewan Government Telephone to erect, place, and maintain its wires across the track of the Canadian Pacific Railway at Richardson, Saskatchewan.

8655 & 8656—November 11th—Authorizing the town of Penetanguishene, Ontario, to lay and thereafter maintain a steel pipe, to replace defective culvert or ditch, under track of the Grand Trunk Railway, at the foot of Queen Street, town of Penetanguishene, Ontario, also to place a sewer pipe under the tracks of the Grand Trunk Railway, at Burke St., said town.

## GAS ENGINE PUMPING vs. HIGH DUTY STEAM PUMPS—By L. G. Read, M.E., A., Mem. C.S.C.E.,

It is now very generally conceded by the engineering fraternity that gas engines have come to stay: indeed, in no branch of applied science has anything like a corresponding advance been made during so short a space of time as in the design and efficiency of the prime mover.

*Chief Engineer of The Colonial Engeering Co., Ltd., 222 St. James Street, Montreal.

A few years ago the internal combustion engine occupied a small field consisting of small units—doing work of small importance, and was not even considered eligible to take the place of an ordinary non-condensing simple steam engine in driving an ordinary ten-hour-per-day factory load. To-day the ten-hour factory load is among the least of its marvellous accomplishments. To-day there is no kind of duty so sensitive, so irregular, or so large that it does not successfully perform.

In paper mills, textile mills, cement mills and central generating stations it has not only proved its own reliability but has maintained its unchallenged superiority over the best performances of steam engines in points of fuel consumption per b.h.p. hour, and now it has entered the field of pumping—the field in which steam engines have attained their most brilliant results. It enters this important field too, not to compete for honors merely against the direct-acting non-fly-wheel make of steam pump, but against the steam pump's "Champion" unit—the high duty type.

With perhaps less than a dozen exceptions, there is not a pumping unit on this continent which is averaging, under ordinary daily working conditions, more than one hundred millions of foot pounds duty per hundred pounds of coal, and it is safe to say that the average foot pound duty—among the municipal pumping plants: that is to say, taking the best average—will fall far below seventy-five millions.

Without going into the reasons—the inherent inefficiencies of a steam plant, whether it be pumping or any other duty, the universally conceded difficulty of maintaining the efficiency of a steam plant under ordinary daily working conditions, etc.—let us compare the showing which a suction gas-engine pump is prepared to make, against a high-duty steam pump.

To begin with—it must be remembered that the results obtained with the steam pump under expert test and the results shown under daily working conditions are vastly different—for the reason that its overall economy depends mainly upon its boiler evaporative efficiency and it is needless to dwell upon the fact that whereas, under expert handling, with all surfaces clean and with proper draft pressure, an evaporation of ten pounds of water per pound of coal may be obtained, this evaporation falls off rapidly under ordinary daily working conditions, and as against which the suction gas engine—having no surfaces to become foul, no varying draft pressure, not depending upon evaporative efficiency, stoking or any of the many other separated elements of the steam plant, maintains its expert results automatically and continuously. And it must be particularly borne in mind that guarantees obtainable on high-duty steam pumps are invariably based upon a given foot pound duty "per thousand pounds of dry steam" — without regard to the amount of coal which may have to be burned in order to supply the "thousand pounds of dry steam," and that the actual yearly coal economy is 35 to 50 per cent. below the usually advertised results. As against this a guarantee is given on the gas engine based upon a given foot pound duty per hundred pounds of coal and covering a period of an entire year's run, thus leaving no doubt as to over-all results or as to its continued economy.

The Hornsby-Stockport gas engine has demonstrated —in many installations in Canada—that, under continuous ordinary daily working conditions, a fuel economy of less than one pound of Pennsylvania anthracite pea coal per h.h.p. hour is obtained; that is to say, it delivers on the engine shaft 33,000 foot pounds x 60 minutes = 1,980,000 foot pounds per hour per pound of coal, or 198,000,000 foot pounds per hour 100 pounds of coal.

Should this engine, therefore, be direct coupled to a multiple-throw pump with an overall efficiency of say 80 per cent, then the combined efficiency would be 198,000,000 x 80 per cent. or a foot pound duty of 158,400,000 per 100 pounds of coal. Using a clean anthracite pea coal (such as is easily obtainable in the Canadian market) at a cost of say $5.00 per ton and pumping against a head of 100 feet—including suction lift—this gas engine has to its credit the phenomenal economy of 22.5 cents fuel cost per 158,400,000 foot pounds duty—net! or, expressed in terms representing daily working conditions, would pump one hundred and fifty eight thousand four hundred Imperial gallons per hour, against 100 feet head, for a total fuel cost of only 22½ cents, or 3,800,000 gallons per 24 hours for a total fuel cost of only $5.40—enough water to supply a city of 30,000 population and with 800,000 gallons per day as a margin. 3,800,000 gallons of water per day for a fuel cost of only $5.40 being equal to only $1.42 per million gallons per day!

It is perfectly safe to say that—with two, possibly three —exceptions, there is not a town in the entire Dominion but what its fuel cost for pumping is from three to ten times this cost. And the above figures represent by no means the best this gas engine can do. They represent an economy which is easily obtainable with small units—say down to 50 b.h.p.

As a matter of fact, in the larger units, say from 250 to 1,000 b.h.p.—a fuel consumption is easily shown of .8 of a pound of coal per b.h.p. hour. Taking, then, the pump efficiency still at 80 per cent., the result would be

$$\frac{158{,}400{,}000}{.8} = 198{,}000{,}000$$

foot pounds per 100 lbs. of coal or a fuel cost of only $1.14 per million gallons against 100 feet head.

No steam pumping unit—though it be of the best design, equipped with the most refined auxiliaries, and operated under the most ideal conditions, can approach such results! Furthermore, this gas engine can be attached to a turbine pump—a pump which is the acme of simplicity by means of the famous Wuest Double Helical Speed Increasing Gear—a gear which, like the gas engine, has recently forced its own merit upon a doubting public—and show results which, under ordinary daily working conditions, are rarely equalled even by the best modern high-duty steam pumps.

Taking one pound of five dollar coal for the gas engine per b.h.p. hour, 97 per cent. efficiency for the gear and a turbine pump efficiency of say 68 per cent., the result (with ample margin of safety) is 33,000 x 60 x 100 x 97 per cent. x 68 per cent. = over 130,000,000 foot pounds duty per 100 pounds of coal.

How many high-duty pumping sets — in the United States and Canada combined—will average a daily working result of even one hundred million foot pounds duty per 100 pounds of coal? Not a dozen!

And yet here is a gas engine, with self-contained enclosed gear and turbine pump—with capital cost, space occupied, cost of maintenance, attendance with maximum simplicity, fewness of parts, ease of accessibility—all in its favor—which, almost without attention, will develop 130,000,000 foot pounds per 100 pounds of coal every day in the year, and with the crowning feature of automatic regulation of its own economy—since not a pound of coal can be consumed except in direct proportion to the actual horse power required on the engine shaft.

In other words the efficiency of the steam plant depends directly upon boiler evaporative economy, and the boiler economy depends directly upon the intelligence with which every pound of coal is fired.

As against these varying and uncertain elements the gas plant eliminates all consideration of evaporative economy, draft pressure or intelligence of firing—by the substitution of a device through which and by no other means, the consumption of fuel is regulated by the movement of the engine piston itself and since variation of piston resistance is instantly met by the action of a sensitive governor, it follows that no fuel can be converted except in direct proportion to the variation of load.

It would be of great interest—did space permit—to go more fully into plotted data covering direct comparisons with actual results. May it suffice, however, for the moment, to say that very shortly a demonstration gas engine pumping set will be installed in Montreal, consisting of a small (55 h.p.) gas engine with Wuest Double Helical gear and a turbine pump, for the purpose of permanent exhibition—that Canadian engineers may see for themselves, not merely expert results; but results obtainable by a continuous 24-hour-per-day performance. This exhibition unit will be equipped with all necessary instruments for pumping under a variety of quantities and heads and any competent engineer will be permitted to make his own tests and satisfy himself as to results.

In a later issue of this journal the writer will deal with the mechanical questions of gears, belt and rope drive of turbine pumps.—[Advt.]

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—The town of St. Louis is asking bids for the construction of a tunnel under the C.P.R. tracks on St. Lawrence Boulevard until 6th December. Plans and specifications to be seen at town engineer's office, 5 Beaver Hall Square, Montreal. A. F. Vincent, sec.-treas.

QUEBEC.—Tenders will be received up to Tuesday, 7th December, for supplying materials and doing the following works from 1st May, 1910, to 1st January, 1911:—Broken stone, broken stone (special), unbroken stone, stone curb, retaining walls, stone and brick pavements, sand, deals, etc., nails. Mr. W. D. Baillairge, city engineer.

QUEBEC.—Contractors for bridge superstructure are invited to visit the office of the Board of Engineers in the Canadian Express Building, Montreal, after January 3rd, 1910, where information may be had to enable them to prepare bids for the superstructure of a 1,758 feet span bridge 88 feet in width. The contractor is invited to submit alternative designs, which must conform to the conditions laid down in the general specification. L. K. Jones, secretary, Department of Railways and Canals, Ottawa. (Advertised in the Canadian Engineer.)

**Ontario.**

COBALT.—Tenders will be received until Monday, December 6th, for grading required in connection with the construction of tracks at Cobalt, Ont. Further particulars are given in our advertising pages. Temiskaming and Northern Ontario Railway, 25 Toronto Street, Toronto.

COBOURG.—Tenders will be received up to Monday, the 6th December, for an 8-inch vitrified tile drain, about 2,000 feet in length and from 6 to 14 feet in depth. D. H. Minaker, Town Clerk.

BERLIN.—Tenders will be received up to 14th December by Edmond Pequegnat, secretary of the Berlin School Board, Berlin, Ont., for the erection of an eight-rooom public school. Munro & Mead, architects, Hamilton, Ont.

TORONTO.—Tenders will be received up to December 7th for the supply of two 5-ton auto trucks. Specifications may be seen upon application at the office of the Medical Health Officer, City Hall.

TORONTO.—Tenders wanted for digging and drilling wells. McBrien Manufacturing Company, Main Street and Bartlett Avenue, or 1,000 Bloor Street West.

TORONTO.—Tenders will be received up to Thursday, December 7th, for the supply, erection and completion of floor beams for the engine-house of the main pumping station. Mr. Joseph Oliver (Mayor), chairman Board of Control. (Advertised in the Canadian Engineer.)

LATCHFORD.—A second-hand 25 or 30-ton yard locomotive is wanted by the Empire Lumber Company, Latchford, Ont.

WALKERTON.—A second-hand open heater and boiler for 80 horse-power steam plant is required by B. P. Kent & Company, of Walkerton.

**Manitoba.**

WINNIPEG.—Tenders will be received up to Thursday, December 9th, for the erection of iron fences at the Alexandra and Isbister Schools. For specifications and form of tender apply to J. B. Mitchell, Commissioner of Buildings, School Board Office.

WINNIPEG.—Tenders for 500 cords of tamarac or jackpine wood will be received up to Thursday, December 9th. For specifications, forms of tender or further information apply to J. B. Mitchell.

WINNIPEG.—Tenders for 600 tons of Youghiogheny steam coal will be received up to Thursday, December 9th. For specifications, forms of tender, or further information apply to J. B. Mitchell.

**British Columbia.**

VANCOUVER.—Tenders will be received until December 10th for the construction of a sewerage system for Vancouver Heights. D.L. 186. Tracy & Kilmer, civil engineers, 411 Howe Street.

VANCOUVER.—Tenders are invited by the clerk of the municipality of South Vancouver for 254,000 feet of ditching for water mains.

VICTORIA.—Tenders are invited for paving materials. The British Columbia Hassam Company have offered to lay a Hassam pavement on Douglas Street for $2.25 a yard, with a ten-year guarantee. Mr. C. H. B. Topp is the city engineer.

NELSON. — By the Nelson Street Railway Company, Limited, tenders are requested for two semi-convertible cars and for station metering and switching equipment, full particulars of which with copies of specifications can be secured at the office of E. B. McDermid, Secretary-treasurer.

## CONTRACTS AWARDED.

**Nova Scotia.**

HALIFAX.—A contract has been awarded to Farquhar Brothers for heating the Chebuctos school.

**Quebec.**

MONTREAL.—A contract for the erection of the new bath in St. Denis Ward was given to Mr. Langevin at $26,500.

**Ontario.**

BURLEIGH.—Some weeks ago we stated that Bishop & Buchanan, of Owen Sound and Peterborough, would probably be awarded a contract for the construction at Burleigh Falls of a dam to cost about $50,000. This was confirmed on Tuesday.

COBOURG.—A contract has been let by the Provincial Steel Company to M. Jex & Company, Cobourg, for a 135 foot extension to the plant here.

HAMILTON.—Sewer contracts were as follows:—J. J. Armstrong got the contract for constructing part of the sewers at the following prices: On Arthur street, 40 cents a foot; on Imperial street, 35 cents a foot; on the private right of way, 40 cents. The engineer's estimates were 47 cents, 39 cents and 41 cents. Andrew Mercer was awarded the contract for constructing that part of the sewer on the base line at 90 cents. The engineer's estimate was 92 cents. Thomas Williamson's tender of $1,325 to lay the iron pipe for the extension of the Ferguson avenue sewer through the revetment wall was accepted.

TORONTO.—For steel work, gates and railings in connection with the Broadview Avenue lavatory, the following tenders were received:—$764.70, $792.75, $720.00, $820.00, $1,051.00. The contract was awarded to W. Groeger, No. 65 Jarvis Street, Toronto, price $720.

TORONTO.—Tenders for 37,600 pounds, approximately, of copper wire for the electrical branch of the works department were as follows: 16 1/10c., 16 35/100c., 16 11/100c., per pound. The Board awarded the contract to the Canadian General Electric Co., Limited at 16 1/10c. per pound.

LONDON.—The Bissel Company, of Toledo, Ohio, have been awarded a contract for 450 35-foot poles at $5.15 each by the Niagara Power Committee of the City Council.

TORONTO.—Contracts have been awarded by the Hydro-Electric Power Commission for heating apparatus for the transformer stations. Two steel boilers will be installed in the Niagara Falls and Toronto stations by John Inglis & Sons, of Toronto, for $515. Two more boilers will be placed in the Dundas and London stations by E. Leonard & Sons, of London, Ont., for $511. Cast iron boilers will be placed in the stations at Guelph and Preston by Taylor, Forbes & Company, of Guelph, for $511. Similar boilers will be installed in Berlin, Stratford, St. Mary's, and St. Thomas, by

the Gurney Foundry Company, Toronto, for $9,520. Cable tenders have also been awarded: Siemens Bros.' Dynamo Works, of Great Britain, are to supply a 12,000-volt induction cable for $21,149, also a submarine cable for $1,943.12, and an underground cable for $1,556.

WOODSTOCK.—The Woodstock Water and Light Commissioners have awarded the contract for the supply of the equipment for the Hydro-Electric power station here to the Canadian General Electric Company, of Toronto, for $20,000.

TORONTO.—Tenders for the supply of 3,000 lineal feet of 60-inch rivetted steel pipe, and 500 lineal feet of special rivetted steel tapered pipe, also 1,782 lineal feet of 60-inch reinforced concrete pipe for the sewage disposal outfall were as follows:—

| Tender | 60-inch Reinforced Concrete Pipe. Bulk Sum. | 60-inch Steel Pipe. Bulk Sum. |
|---|---|---|
| No. 1 | ..... | $41,000 00 |
| " 2 | ..... | 56,630 00 |
| " 3 | $21,562 00 | ..... |
| " 4 | 21,500 00 | ..... |
| " 5 | 18,855 00 | ..... |
| " 6 | ..... | 55,530 00 |
| " 7 (Informal | ..... | 57,600 00 |
| " 8 | ..... | 48,152 00 |
| " 9 (Informal) | ..... | 74,000 00 |

Tender No. 1, of the Canada Foundry Company, Toronto, for rivetted steel pipe, and tender No. 5, of Mr. E. W. Hyde, jr., for reinforced concrete pipe were accepted. The rivetted steel pipe is to be used out in the lake, and the reinforced concrete pipe across Ashbridge's Bay.

**British Columbia**

VANCOUVER.—Palmer Bros. & Henning, were awarded a contract for the substructure of the new Cambie steel bridge, at $212,600, while the Canadian Bridge Company, Limited, of Walkerville, Ontario, received the contract for the superstructure at $439,210. Full particulars of all tenders submitted and figures showing dimensions, etc., were printed on page 607 of our issue last week.

VANCOUVER.—The Western Engineering Company, Ltd., have been awarded a contract by the municipality of South Vancouver for an electric plunger pump at $925. The pump will be made by Messrs. Hayward, Taylor & Company, of London, England, and will be driven by an A. C. motor. It will be designed to deliver 6,400 gallons of clear water per hour through 7,000 feet of six-inch pipe with a total head of 200 feet. The following firms were awarded contracts for water fixtures: Messrs. Crane & Company for galvanized fittings, amounting to $147.13; the Terminal City Iron Works Company for cast iron specials, amounting to $2,033.36; the Canadian Fairbanks Company for galvanized iron piping amounting to $2,350.80, also for brass goods amounting to $1,814.68; Messrs. Robertson, Godson & Company for hydrants at $48 each. The British Columbia Electric Company was given an order for lighting, which will involve the installation of 150 arc lights.

VICTORIA.—At a recent meeting of the City Council tenders for twelve iron posts, to be erected on the Causeway for street lighting purposes, and to support the trolley wires, were received from Andrew Gray at $1,300, and from Hutchinson Brothers at $1,500. The tenders were referred to the electric lighting committee and the purchasing agent to award the contract. The tender of the Colbert Heating and Plumbing Company for twenty tons of pig lead at $3.59 per 100 pounds was accepted.

A despatch from Ottawa says the Dominion Railway Commission on December 7 will consider the question of issuing a general order compelling all railways under its jurisdiction to equip cars with air brakes. The matter will come up in connection with an application recently made for an order of the board requiring air brakes equipment to be placed on the cars of the Hamilton & Buffalo and the Hamilton Radial Electric Railways, which are Federally incorporated. Should the board decide to issue a general order the other electric railways affected will be the Essex Terminal, the Oshawa Railway, the Ottawa Electric, the Hull Electric, the Montreal Park and Island, the Montreal Terminal Company, the Quebec Railway, the St. John, N.B., Railway Company

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—Three consulting engineers from New York city have been paying a quiet professional visit to Montreal during the past week and although no authoritative statement as to their business was given out, it is believed they are looking over the ground with a view to furnishing plans and estimates for either an elevated or an underground street railway system in the heart of the city.

**Ontario**

COBOURG.—Every section of the C.N.R. in Northumberland and Durham Counties is the scene of much activity. Between Trenton and Brighton over four miles of track is already graded, while the right-of-way is nearly all fenced in. Mr. J. O. Giroux, contractor at Colborne, brought in a train load of horses recently and work is being pushed in that vicinity. The route is through a fine stretch of country, and it is said that the heaviest grade in the road and greatest curve will be but three degrees, and this where the C.N.R. joins the C.O.R. near Trenton.

KINGSTON.—An agreement has been reached between the City council and the Street Railway Company, who have accepted the terms offered a month ago by the Light, Heat and Power Committee. Mr. H. W. Richardson, president of the railway signed a contract for five years to take power at $1,20 per kilowatt hour. The service has been discontinued for several days.

NIAGARA FALLS.—A newspaper report says the council of Stamford Township have ordered the Niagara and St Catharines Street Railway Company to tear up their track or restore a twenty-minute service between Falls View and Montrose station.

OTTAWA.—The Grand Trunk Pacific Branch Lines Company will apply to the parliament of Canada at its present session for an act authorizing the construction of the following additional lines of railway: From a point on the western division of the G.T.P. railway between the east limit of range 12 and the west limit of range 17 west of the third meridian, thence in a southwesterly and westerly direction to a point in the vicinity of Calgary or to a point on the line which the company is authorized under paragraph 14 of clause 11 of said chapter 99 to construct to Calgary. From a point on the proposed line mentioned in the preceding paragraph between the east limit of range 20, and the west limit of range 28 west of the third meridian, thence in an easterly and southeasterly direction to Regina or to a point in the vicinity thereof. From a point in the proposed line mentioned in paragraph 2 between the east limit of range 24, and west limit of range 27, west of second meridian, to Moose Jaw, or to a point in the vicinity thereof. From a point on the western division of the G.T.P. between Artland and Wainwright, thence in an easterly and southeasterly direction to a point on the line which the company is authorized to construct to Battleford. From Regina or a point in the vicinity thereof, thence in a southwesterly and westerly direction to Lethbridge or to a point in the vicinity of Lethbridge on a line which the company is authorized to construct from Calgary to the boundary of the province of Albert at or near Coutts. The company will also ask for power authorizing the issue of bonds to the extent of $30,000 a mile for its said lines of railway and comprising the said lines within what are defined as the "Manitoba Saskatchewan and Alberta extensions."

PORT ARTHUR.—Several parties of C.N.R. engineers are out working near Nepigon surveying a right-of-way. One party, in charge of Engineer Rose, is surveying between the Nepigon River and Long Lake and the other party is operating near Red Rock, between Nepigon River and Black Sturgeon River. The C.N.R. right-of-way is understood to cross the Nepigon River at Deschamps. The track will run close to the C.P.R. line at this point.

ST. THOMAS.—The commissioners of the municipally-owned street railway here, contemplate the purchase of two new cars, the installation of new motors and extensions, and debentures will probably be issued at an early date to provide the money.

TORONTO.—An offer to construct and operate a tube railway here, for 12 years, has been made by Messrs. Watson, Smoke, Chisholm & Smith, on behalf of a client of theirs whose identity has not been made public.

**Manitoba.**

WINNIPEG.—The Alberta and Great Waterways Railway northern line is now being rushed ahead rapidly, and it is expected to have the whole 350 miles of line completed by 1911. This announcment was made by Mr. J. A. L. Waddell, chief engineer for the company, who arrived in Winnipeg on Monday to engage engineers for the survey operations. Ten miles of grading have been finished, and Mr. Waddell stated that this work was to be pushed ahead with all possible despatch.

**Alberta**

EDMONTON.—By a majority of 1,311, the people of Edmonton carried a by-law connected with the entrance of the C.P.R. to the city. The terms include the construction of overhead bridges and subways on the streets crossed, the city assuming all liability for property damages.

## LIGHT, HEAT, AND POWER.

**Ontario.**

HAMILTON.—After a long fight in the council and in the courts the city council unanimously decided on Monday to enter into a contract with the Ontario Hydro-Electric Power Commission for 1,000 h.p., on terms outlined by the Commission.

LONDON.—A contract with the London Electric Company for street lighting, was made this week, for one year, with a three-months' cancellation clause. If the city desire to break the contract by giving the necessary notice, a sliding scale of prices as presented by Mr. Chas. B. Hunt, the manager, will be paid, but if it runs the whole year, the present price, 23 cents per lamp, per night, will hold good.

OTTAWA.—At a meeting of the Eastview council on Wednesday night the first reading of a by-law to give the Ottawa Electric Company a ten year franchise to operate in the village and use of the streets, etc., came up. The rates fixed in the franchise are very nearly the same as those in the city. The franchise will be exclusive for five years, and after that the company will be liable to competition.

**British Columbia.**

FERNIE.—The fires were lighted under the boilers of the new municipal electric lighting plant at Fernie, for the first time, on November 19th, and the machinery was found to be in a most satisfactory condition. The consumers in the city will probably be supplied with electric light in a few days and the streets of the city will then be lighted properly, the first time since the fire destroyed the equipment. The arc lamps for the principal streets are already in position.

## SEWERAGE AND WATERWORKS.

**Ontario.**

HAMILTON.—The City Engineer will lay out a sewer scheme for the southwestern corner of the new annex, and a new tank will be erected at the Ferguson Avenue sewage disposal plant.

## FINANCING PUBLIC WORKS.

**Ontario.**

MIDLAND.—This town offers for sale until December 14th, $12,000 bonds, the proceeds of which will be used for walks and sewers. Thos. I. Trueman, secretary-treasurer.

TORONTO.—Three money by-laws are to be submitted to the ratepayers of Toronto on January 1. They are to provide for issuing debentures as follows: To raise $759,000 for the extension of Bloor Street easterly to Danforth Avenue, and the construction of a viaduct in connection therewith; to raise $320,000 for new buildings at the Exhibition grounds, and $262,000 for the purchase of lands and the erection thereon of six buildings for the fire department and four police stations.

**Manitoba.**

MINIOTA.—Until December 7th, telephone debentures amounting to $12,000 are offered for sale by this municipality. Wm. Howard, secretary-treasurer.

VIRDEN.—Debentures amounting to $25,000 are offered for sale until December 20th by the rural municipality of Pipestone, Man. A. P. Power, secretary-treasurer., Virden, Man.

**British Columbia**

VANCOUVER. Tenders are invited by the North Vancouver City Ferries, Limited, for $128,000 debentures guaranteed by the City of North Vancouver. Tenders must be lodged before noon of the 22nd December. H. E. Kemp, secretary.

The following municipalities recently sold debentures:—Blind River, Ont., $12,000, town hall, etc.; Exeter, Ont., $22,000, waterworks; Stamford Township, Ont., $8,700, local improvements; Abernethy, Sask., $3,000, telephone, streets and sidewalks; Wetaskiwin, Alta., $2,328, local improvements; North Vancouver, B. C., $62,474, local improvements and loans; Victoria, B. C., $170,000, sewers and waterworks.

## MISCELLANEOUS.

**Ontario.**

TORONTO.—City Engineer Rust estimates that it will cost $800 to install an electric bell at Wallace Avenue railway crossing and $150 per annum to maintain it.

**Alberta**

EDMONTON.—The largest expenditures of the year for public works have been as follows:—Power plant, $320,000; paving, $125,000; new water main, $40,000; water and sewer, $40,000; plank sidewalks, $16,000; boulevards, $16,000; Kinnaird St. bridge, $6,000; East End Park, $5,000; opening streets, etc., $4,000.

## PERSONAL NOTES.

MR. E. A. SCHAUFFELBERGER, of the firm of Jens Orten-Böving & Company, London, England, was in Toronto this week on a business trip.

MR. G. E. MASON, representing the Lancashire Dynamo and Motor Company, of Manchester, England, has opened a Canadian office at 154 Bay Street, Toronto, Ont.

SUPERINTENDENT WILCOX, of Dauphin Division of the C.N.R. is re-appointed superintendent of the Winnipeg-Port Arthur division, succeeding C. D. Murphy, resigned.

MESSRS. RIDOUT & MAYBEE, patent solicitors, Toronto, after occupying offices at 103 Bay Street for sixteen years have removed to more convenient premises in the Manning Chambers, at the west side of the City Hall, Queen Street West.

## OBITUARY.

MR. HUGO GROUT, C.E., one of the most prominent men of the Niagara district, died suddenly on November 25 at St. Catharines, aged 78. He was born in Grimsby. One brother, Canon Grout, of Kingston, survives. His other brother, John, was one of the first manufacturers of harvest implements in Canada. Mr. Grout was for thirty years in the employ of the old Atlantic & Great Western Railway Company.

MR. W. McLEA WALBANK, first vice-president of the Montreal Light, Heat and Power Company, died at his residence 241 Peel Street, Montreal, Que., November 28th, 1909.

Mr. Walbank was born at St. Johns, Newfoundland, the son of the late M. W. Walbank, Q.C. He received his early education in his native town, afterwards attending for two years Queen's University, Dublin. In 1875 he came to Canada and in 1877 graduated from McGill University with the degree of Bachelor of Applied Science. Shortly after he was admitted to the Provincial Land Surveyor's Association, of which at a later date he was vice-president.

For several years Mr. Walbank practised the profession of an architect in the firm of Bulman & Walbank, but drifted more and more into active engineering work especially hydraulic engineering, and finally turned his attention altogether to this work.

His great work has been with old Lachine Rapids Hydraulic and Land Company, and afterwards with the Montreal Light, Heat and Power Company, when the two companies amalgamated.

Although Mr. Walbank's creation lost its identity by the amalgamation, he did not lose his as he became vice-presi-

dent of the Power Company and the chief engineering authority of the big concern.

As managing director, Mr. Walbank secured for the Machine Company the control of the Shawinigan Power Company's interest on the island of Montreal. He was also interested in other power schemes in Montreal and was president of the Citizens' Light and Power Company and of the Standard Light and Power Company of Montreal.

During his active business career Mr. Walbank took a prominent part in the activities of the various organizations among the local engineers. He was one of the founders of the Canadian Society of Civil Engineers, and in 1907 became president of that body. He was also a member of the Engineers Club, and in 1904 was vice-president.

## CANADIAN PATENTS.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, Manning Chambers, Toronto, from whom further particulars may be obtained :—Franklin Sidey, harness ; Dr. Anton Messerschmitt, process for producing hydrogen; W. J. Green, branding machines; John H. Hall, means of securing spare rims; Wm. H. Hazard, strainers; E. E. M. Payne, purification of water; Friedrich Luthke, motor-waggon; Albert De Dion & Georges Bouton, motor-sleigh; J. F. Stephenson, joints of bedsteads.

Following is the weekly list of patents recently granted to Canadian inventors in Canada, which is furnished by Messrs. Fetherstonhaugh & Co., patent barristers, Royal Bank building, 10 King Street east:—A. Drowley, Priceville, Ont., snow plows; W. J. Curry Victoria, B.C., mops; J. M. Fleming, Ottawa, Ont., automatic regulating means for smoke consumers; J. R. Hamilton, St. John, N.B., combination tools and utensils; F. W. Harris, Owen Sound, Ont., high chairs; B. J. Hayes, Montreal, Que., coat hangers; W. H. Heard, London, Ont., spraying apparatus; J. H. Jackson, Hamilton, typewriting machines; P. Houston, Ottawa, Ont., warning signals for bridges and the like ; L. G. Mickles, Toronto, Ont., tires; J. Moore, London, Ont., ball-bearing chimney and ventilator tops to increase the draft; J. C. Nichol, Ottawa, Ont., lubricators for car axels journals; A. Noland, Midland, Ont., feed boxes for horses; T. H. Speight, Markham, Ont., waggon gears; R. Sylvester, Lindsay, Ont., travelling threshing machines; M. Whitman, Vancouver, B.C., sheaves; B. D. Wright, London, seamless caps; W. Atkins, St. John, N.B., nut locks; I. Wynn, Arnprior, Ont., gates for railway crossings and the like and means for operating same; W. Bolt, Wingham, Ont., railway crossing gates; J. H. Field, Victoria, B. C., electric alarm and call bell system.

## RAILWAY ORDERS

(Continued from page 628).

8679—November 17th—Authorizing the H. A. Clemens Company, Limited, of the city of Guelph, Ontario, to construct and thereafter maintain a water pipe under the track of the Canadian Pacific Railway, near the Bramosa Bridge, Guelph, Ontario.

8680—November 4—Directing that the C.P.R. forthwith erect a shelter on or near the wharf at East Robson, B.C., suitable for the protection from the weather of merchandise shipped to or to be shipped from that point, by the boats of the C.P.R.

8681—November 8—Dismissing application town of Lemberg, Sask., for authority to open Main Street, in said town, in a northerly direction across the property and tracks of the C.P.R.

8682—November 4—Dismissing complaint of A. E. Watts, of Cranbrook, B.C., with regard to inflammable material left on right-of-ways of railways, and the destruction of public roads, including the one from Yank to Copeland, and Seymous to Vernon, B.C.


## TO CONTRACTORS

Tenders will be received by the Minister of Public Works until noon on Tuesday, the 14th December, for the fireproofing work and materials required in connection with the reconstruction of the Parliament Buildings, including terra cotta arching, partition work and concrete, etc.

Plans and specifications may be seen and other information obtained at the offices of the architect, E. J. Lennox, 164 Bay St., Toronto. An accepted bank cheque payable to the order of the Honorable the Provincial Treasurer, for five per cent. of the amount of the tender and the bona fide signatures and addresses of two sureties or the name of a guarantee company, approved by this department, prepared to give a bond for the due fulfilment of the contract, must accompany each tender. Cheque will become forfeit to the crown in the event of the successful tenderer refusing to carry out the work within ten days after the acceptance. The department will not be bound to accept the lowest or any tender.

J. O. REAUME,
Minister of Public Works, Ontario.

Department of Public Works, Ontario, Toronto, December, 1st, 1909.

Newspapers publishing this advertisement without authority will not be paid for it.


8683—November 4—Dismissing complaint of the Kootenay Shingle Company, of Salmo, B.C., that the C.N.R. has departed from the tariffs fixed by the Board with respect to rates, weights, and shortage on shipments of shingles originating at Salmo and consigned to points in British Columbia, Alberta, and Ontario.

8684—November 18—Granting leave to the East Luther and Amaranth Telephone Company to install a telephone instrument in the station of the C.P.R. at Grand Valley, Ont.

8685—February 5—Authorizing the corporation of the city of Winnipeg, Man., to construct a subway under its tracks on the east side of McPhillips Street, between Fonseca Avenue and Jarvis Street, said city.

8686—November 18—Authorizing the G.T.P. Railway to put on a tri-weekly mixed train service between Wainwright and Edmonton, Alta.

8687—November 18—Authorizing the city of Brantford, Ont., to lay and thereafter maintain a sewer pipe under the tracks of the T. H. & B. Railway at Gilkinson Street, between Walnut and Richardson Streets, Brantford, Ont.

8688—November 18—Granting leave to the Farmers' Telephone Company, Limited, to erect, place and maintain its telephone wires across the track of the C.P.R. at south side of highway, Parish of Northampton, County of Carleton, N.B.

8689 and 8690—November 18—Granting leave to the Farmers' Telephone Company, Limited, to erect, place, and maintain its telephone wires across the track of the C.P.R. Company's tracks at south side of highway parish of Brighton, N.B., and at Maple Street, village of Hartland, N.B.

8691—November 18—Authorizing the C.N.R. to open for the carriage of traffic that portion of its line from Saskatoon to Rosetown, Sask., a distance of 72 miles.

8692—November 17—Authorizing the C.P.R. to construct, maintain, and operate a system of industrial spurs, consisting of three tracks, across road allowance between Sections

22 and 23, Tp. 24, R. 9, west of 5th Meridian, and five other spurs in vicinity near Exshaw, Alta.

open for the carriage of traffic the extension of its Snowflake Branch to Windygates, Manitoba, mileage 0 to 0.5.

8605—November 18.—Recommending to the Governor-in-Council for sanction agreement of the C.N.R. with the Northern Extension Railway Company.

## MARKET CONDITIONS.

Montreal, December 2nd, 1909.

An estimate of the money value of the sales of wire products in the United States during the month of November, is $20,00[illegible] to $25,[illegible]. In the matter of raw material, however, the tendency of prices has been downwards. There has been a sharp contraction of business and a reaction in prices of pig iron and coke. Speculative holders of foundry iron were forced to sell their holdings, yet the total volume of business was but little over one-third of what it was in October. In October, sales were 300,000 tons per week while the total sales in November were but [illegible] tons, including foundry, forge and steel making iron. Meantime, prices have run down all the way from 50c. to $1 per ton. There has also been some pressure to sell spot coke, and ovens have been offering concessions in order to dispose of accumulations. So far as the price of ore is concerned, there has been no reaction in prices among United States mines, but offers have been coming in from abroad to accept lower figures, the result being that more Spanish and Swedish ore has been sold for importation into the country. Finishers of material have been eager to obtain steel billets and have been making large purchases for delivery over the first half of 1910. Taking railway contracts, all round, considerable activity is observable, particularly in the matter of cars, although very little was done in locomotives and rails. There was considerable ordering of structural steel, and the activity promises to keep up.

The market in Great Britain is very quiet and uninteresting. Prices are still maintained but no advance has developed and the tendency is barely steady. Unfinished material is rather firm in tone, owing to the fact that it did not previously follow the advance in raw material.

In the local market, demand continues good. Orders are being received right along for general foundry grades for winter delivery, at advancing prices, and merchants are expressing themselves as greatly encouraged by the situation. It is said that the only furnace with accumulations is a small one and it is holding buyers off rather than encouraging them.

Prices of finished and semi-finished material are generally steady but alterations are now looked for to occur at almost any time. The Hamilton Steel and Iron Company has withdrawn prices on iron and steel bars and similar material, and it is expected that this means that prices are to be advanced by producers, all round. Prices for pig-iron, meantime, have been altered from a basis of dock to ex-store, practically all the iron having now been moved into store. The following quotations are offered —

**Antimony.**—The market is steady at 8 to 8½c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows.—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c. 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colhorne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, ex-store, Montreal, prompt delivery; No. 1 Summerlee, $21.50 to $22 per ton; selected Summerlee, $21 to $21.50; soft Summerlee, $20.50 to $21; Clarence, $19.50 to $20; Carron, No. 1, $21.50 to $22, and Carron special, $21 to $21.50.

**Lathe.**—See Lumber, etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet, white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.5[illegible]; XX, $2.5[illegible]; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron shop or field $1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.** The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 69 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $118.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are firmer at $2.45 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32½ to 33c.

**Zinc.**—The tone is steady, at 6 to 6¼c.

### CAMP SUPPLIES.

**Beans.**—Prime pea beans, $1.85 per bushel.

**Butter.**—September and October creamery, 26c.; dairy, 22 to 24c

**Canned Goods.**—Per Dozen. Corn, [illegible] to 82½c.; peas, $1 to $1.10; beans, 75 to 80c.; tomatoes, 82½ to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.3[illegible]; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65.

**Cheese.**—Late makes, 11¼ to 11½c.; finest makes, ½c. more.

**Coffee.**—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c.

**Dried Fruits.**—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6c; California, seeded, 7½ to 9c.; Sultana, 10c. Evaporated apples, prime, 9¼ to 9¾c.

**Eggs.**—No. 1 candled, 26c.; selects, 29 to 30c.; new laid, 35c.

**Flour.**—Manitoba, 1st patents, $5.70 per barrel; 2nd patents, $5.20; strong bakers, $5.

**Molasses and Syrup.**—Molasses, New Orleans, 28 to 30c.; Barbadoes, 40 to 50c.; Porto Rico, 40 to 45c.; syrup, barrels, 3½c., 2-lb. tins, 2 dozen to case, $2.50 per case.

**Potatoes.**—Per 90 lbs., good quality, 50 to 60c.

**Rice and Tapioca.**—Rice, grade B., in 100-lb. bags, $2.95 to $3; C.C., $2.90. Tapioca, medium pearl, 4½ to 4¾c.

**Rolled Oats.**—Oatmeal, $2.45 per bag; rolled oats, $2.20, bags.

**Tea.**—Japans, 20 to 40c.; Ceylons, 20 to 40c.; Ceylon, greens, 20 to 25c.; China, greens, 25 to 50c.; low-grades, down to 15c.

* * * *

Toronto, December 2nd, 1909.

The continued open weather favorable to building keeps the price of building supplies steady. If any change it is a slight advance.

Orders for next season's work are being taken at this year's prices, but for structural steel work the large firms are not anxious for orders as they expect prices to advance.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1¼-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.40 without bags, or $1.70 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady. A good deal moving in filling former contracts.

**Coal.**—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50.

**Copper Ingot.**—Demand quite heavy, and price advanced to 14¼c. Supply adequate.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs. Much is being now used for lumber camps.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is good.

**Lumber.**—Prices continue steady, and city demand still active. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, weak, and rather over-stocked, $3 to $3.10; lath, No. 1, $4.40, white pine, 42-inch; No. 2, $3.75; for 32-inch, $1.60.

**Nails.**—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.0c. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—Dealers report a large demand, the prices being as before, per catalogue

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7. There is still a scarcity of good slaters and much demand for them.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .00 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—We do not alter prices as yet; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a good demand exists, and there is prospect of higher prices.

**Sheets Galvanized.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. Demand very active.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

## CAMP SUPPLIES.

**Beans.**—Hand picked, $2; prime, $1.90.

**Butter.**—Dairy prints, 21 to 22c.; creamery rolls, 26 to 27c.

**Canned Goods.**—Peas, $1.00 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; corn, 75 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 9½c.

**Eggs.**—New laid, 25 to 26c. per dozen, in case lots.

**Flour.**—Manitoba Flour.—Quotations at Toronto are:—First patents, $5.60; second patents, $5.10; strong bakers', $4.90; 90 per cents., Glasgow freights, 28s. 6d. Ontario Flour.—Winter wheat patents, for export, $4.20 to $4.25, in buyers' sacks outside.

**Lard.**—Tierces, 15½c.; tub, 15¾ to 16c.; pails, 16c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 75c. a bag.

**Pork.**—Market uncertain. Short cut, $28 per barrel; mess, $26.50.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 14 to 14½c., tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 14½ to 14¾c.; breakfast bacon, 17c.; backs (plain), 18 to 19c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked. Market very firm.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, November 30th, 1909.

The Winnipeg market is steady and a fair demand is still noted all around, especially for supplies for interior work; this demand, it is expected will be well kept up, but depends to a certain extent on the weather. There has been no severe weather so far, and several large contractors are still rushing outside work on a few large buildings that were not completed.

In conversation last week with the Winnipeg representatives of a large American steel exporting firm, they stated that architects, engineers, and contractors would do well to anticipate their steel requirements at as early a date as possible, if they wish to get delivery of their orders in time for them to get on with their work in the early spring. They also report a strengthening tendency in the steel market following the general advance of a month or so ago. While there has been no actual advance named, prices are now perceptibly stronger than they were a month ago, and the outlook is for a continuing stronger market situation. Wholesale hardware and crockery dealers have been having a run on lamps in Winnipeg during the past week, caused by the break down of the Winnipeg Electric Railway Company's power plant at Point du Bois. The demand for cement is fairly strong still, and lumber also continues to be active. Dealers in cement on this market state that in the spring they expect the price of cement to go higher, and in fact look for higher prices all around next spring, if present indications hold good.

Winnipeg quotations are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 1 White Pine, 6 in., $55; cull red or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2

# The Canadian Engineer

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## The Canadian Engineer

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## ACCIDENTS AND INJURIES ON THE RAILROAD.

Elsewhere in this issue will be found a statement of the killed and injured on Canadian railways. By far the greater number killed were trespassers. Added to these, the forty-nine found dead on the track give one hundred and thirty-two, or almost one-third of the total killed.

The level crossing is reported as responsible for forty-one deaths and fifty-four injuries. Altogether, the report shows a falling off in killed of eighty-one and of injured one hundred and eight.

If the figures indicate anything, they indicate that for both the travelling public and the employee railway operation is becoming safer.

In Canada, there were 64 persons killed on the railway per million of population and 171 injured per million.

In the United States there were 144 per million of population killed and 1,400 per million of population injured.

The public have a duty in this matter as well as the railroads. The railway trespasser not only leads many to death in his own path, but so long as he is a large contributor to railway fatalities it will be difficult to close the lines and prevent accidents from other causes.

## GOOD ROADS WITHOUT GRAFT.

The chief business of our Canadian municipal councils is to give us good roads. Highways safe and easy to travel. Roads that will bring the producer near to the consumer. Good roads are one of the best investments our rural municipalities can make.

It is unfortunate that here and there some municipal official, elected or appointed, imagines he can "graft" without meeting the grafter's fate. His petty graft may not amount to much, but it discourages the ratepayer, and in every new demand he fears that out of every dollar voted so much "sticks" where it will do no good. Worse than that, some "grafters" get bold and try to "hold up" contractors and business concerns that have made a name for themselves through honest dealing and good workmanship.

Last week Zorra—that far-famed Ontario township—had a scandal all its own. A bridge builder accused township officials of bribing him. The officials deny the charge. The judge will later give his opinion of the transactions, or the supposed transactions.

It was unfortunate that in connection with this trial there should be coupled the name of the Hamilton Bridge Works Company. Press despatches made it appear as if one of the witnesses, who said he paid money to township officials, was an agent of this company.

Such was not the case. A more careful study of the evidence goes to show that in no manner whatsoever were this firm connected with the deal.

The Hamilton Bridge Company have built up a large business by honest dealing, careful bidding and good workmanship. And it is unfortunate that their name should in any way be misreported in such a transaction. To those who know and have done business with them, the company's denial was unnecessary.

## W. McLEA WALBANK.

The death of Mr. W. McLea Walbank, past president of the Canadian Society of Civil Engineers and managing director of the Montreal Light, Heat and Power Company, removes from engineering circles an active, forceful man, who, during recent years, has made himself felt among his associates in his chosen profession of engineering and in the business world.

Mr. Walbank was an enthusiast in every enterprise or organization with which he affiliated himself. No matter what the discouragement, he fought hard, and—usually won.

He was fair with his opponents, and he will be much missed from the industrial life of the city in which he lived for many years, and from the councils of the organization with which he was identified.

## EDITORIAL NOTES.

This week we placed six engineers in positions such as they wished—we have openings for more. We would be pleased to have a record of your experience. You may be just the man some firm is looking for.

* * * *

The date of the annual meeting of the Canadian Society of Civil Engineers at Ottawa, Ont., has been fixed for January 25th, 26th and 27th, 1910, one day earlier than the date given last week. The annual dinner will be held on Wednesday evening, and will be especially good, as Parliament is closed that evening and many members will attend.

* * * *

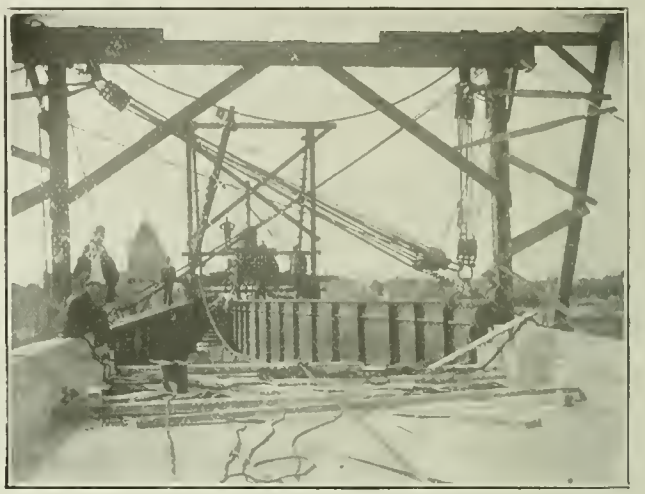
The National Society for the Promotion of Industrial Education have just closed a successful convention at Milwaukee. The objects of this association are to bring to public attention the importance of industrial education as a factor in the industrial and educational development of the country, and to promote the establishment of institutions for industrial training.

## FIRST STREET BRIDGE, BRANDON, MAN.

R. E. Speakman, M. Can. Soc. C.E.*

This bridge, which is just completed, crosses the tracks of the Canadian Pacific Railway and Assiniboine River, and has been constructed jointly by the City of Brandon and the Canadian Pacific Railway Company.

The foundations of the piers and abutments, which are of very massive reinforced concrete, as well as of the concrete arches on the north of the river, are built upon piles driven to a solid bearing.



**First Street Bridge, Brandon, Man.**

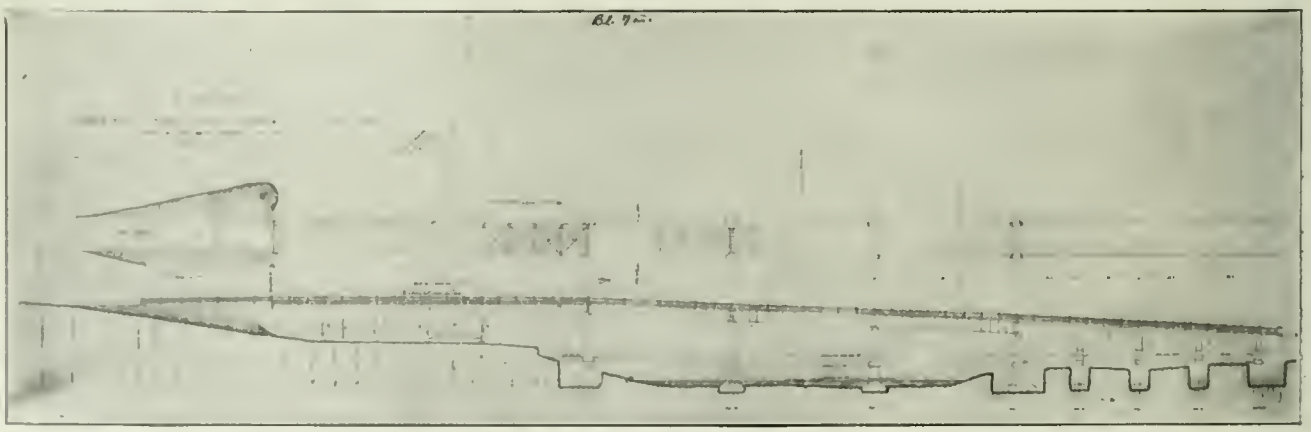
The steel superstructure was built by the Dominion Bridge Company, of Montreal, during the year 1909, and has just been satisfactorily completed.

The superstructure over the Canadian Pacific Railway consists of four spans of 35 feet 3 inches and one of 71 feet 9½ inches, supported on steel braced towers and at the north end upon one of the concrete towers, and is of plate grider construction.

The superstructure over the Assiniboine River is constructed upon reinforced braced concrete columns, at 96 feet centres, the main plate girders being 8.0¾ in depth.

The superstructure of the Assiniboine Avenue approach is supported on steel braced towers upon concrete pedestals.

The roadway throughout is covered with 6-inch reinforced concrete, upon which is laid 4-inch creosoted wood blocks, grouted in with asphalt.



**Plan of First Street Bridge, Brandon, Man.**

The total length of the bridge is as follows:—

| | Feet. |
|---|---|
| Earth approach south end ..... | 132 |
| Bridge over C.P.R. ..... | 213 |

* [Mr. Speakman is city engineer of Brandon, Man., and engineer in charge of this work at its completion. Ed. Can. Eng.]

| | |
|---|---|
| Over Assiniboine River, three spans 96 feet centres | 288 |
| Four reinforced concrete arches, 40 ft. centres | 161 |
| North earth approach | 230 |
| | 1,024 |
| Assiniboine Avenue approach 141, with earth embankment 250 | 391 |
| Total length | 1,415 |

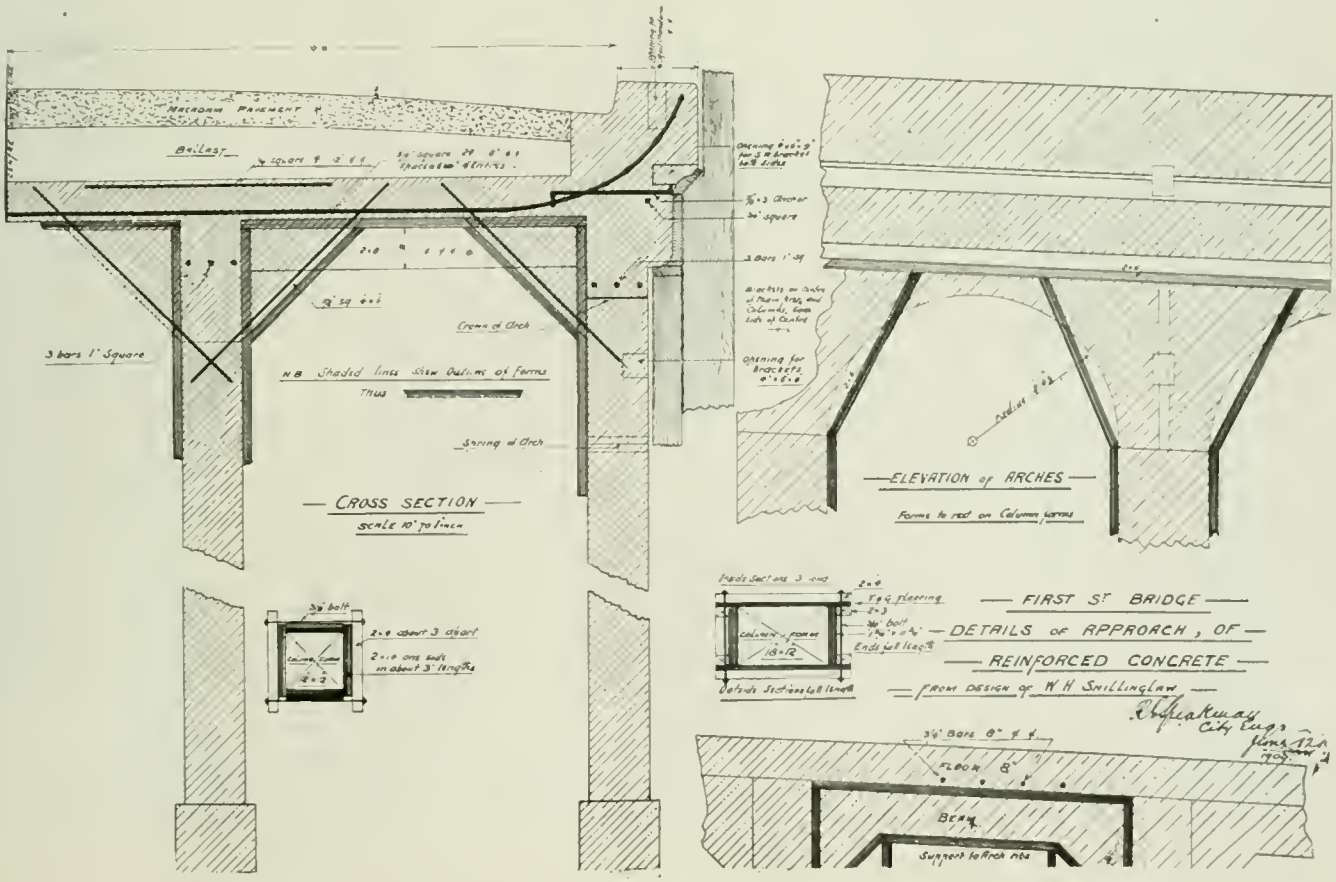
**Details of Concrete Arch Construction.**

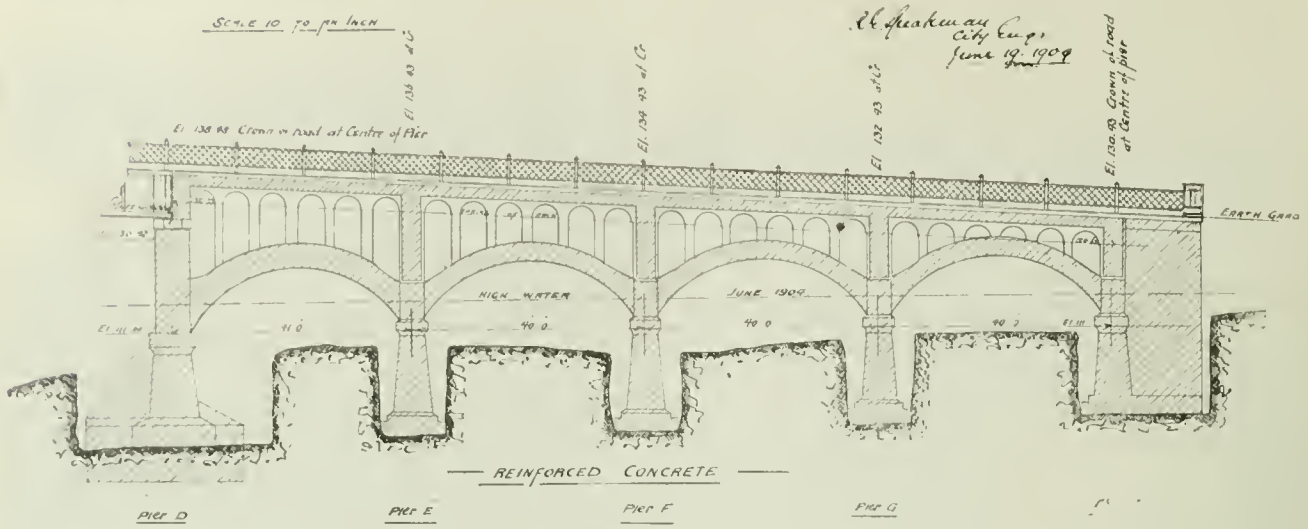
The detail plans herewith enclosed will explain the construction of the work, which was done by the city by day labor. During the year 1908, the piling was driven as follows:—

| | | |
|---|---|---|
| Pier | A | 40 Piles |
| " | B | 40 " |
| " | C | 40 " |
| " | D | 58 " |
| " | E | 24 " |
| " | F | 24 " |
| " | G | 24 " |
| " | H | 41 " |
| Total | | 291 piles driven |

to solid bearing, the average depth being from 15 to 22 feet.

Test piles driven into this soil showed the following results with a 2,000 lb. drop hammer.


— CROSS SECTION —
scale 10' to inch
— ELEVATION of ARCHES —
— FIRST ST BRIDGE —
— DETAILS of APPROACH, OF —
— REINFORCED CONCRETE —
— from design of W. H. SHILLINGLAW —




**North Approach to First St. Bridge**

51 to 60 blows 18 ft. drop. Average per blow 1′ 6″
61 to 70 blows 19 ft. drop. Average per blow 1′ 4″
71 to 80 blows 19 ft. drop. Average per blow 1′ 3″
81 to 87 blows 21 ft. drop. Average per blow 1′ 2″

The piles used were 25 foot tamarac.

The concrete foundations, piers, columns, and to the extrados of the main arches were constructed in the year 1908 by Mr. W. H. Shillinglaw, city engineer, and his assistant, Mr. N. E. Gibson, C.E., and are reinforced with the "Kahn" system obtained from the "Trussed Concrete Steel Company," of Walkerville, Ontario. The work was carried on to completion during this year by the writer, with the assistance of Mr. William Smith, city foreman.

The concrete used for the floors of the entire bridge was proportioned as follows:—

1 Portland cement.
1 Clean coarse sand.
1 Granite dust.
4 Crushed granite,

and for the foundations, piers, columns, and arches, was proportioned as follows:—

1 Portland cement, Rathbun's "Star."
3 Clean sharp sand.
6 Crushed granite,

with 6-inch facing of 1 : 2 : 4 mixture.

The floors being reinforced by 5/8-inch stel bars spaced 8-inch centres.

The bridge is designed to carry a live load of 100 lbs. per square foot.

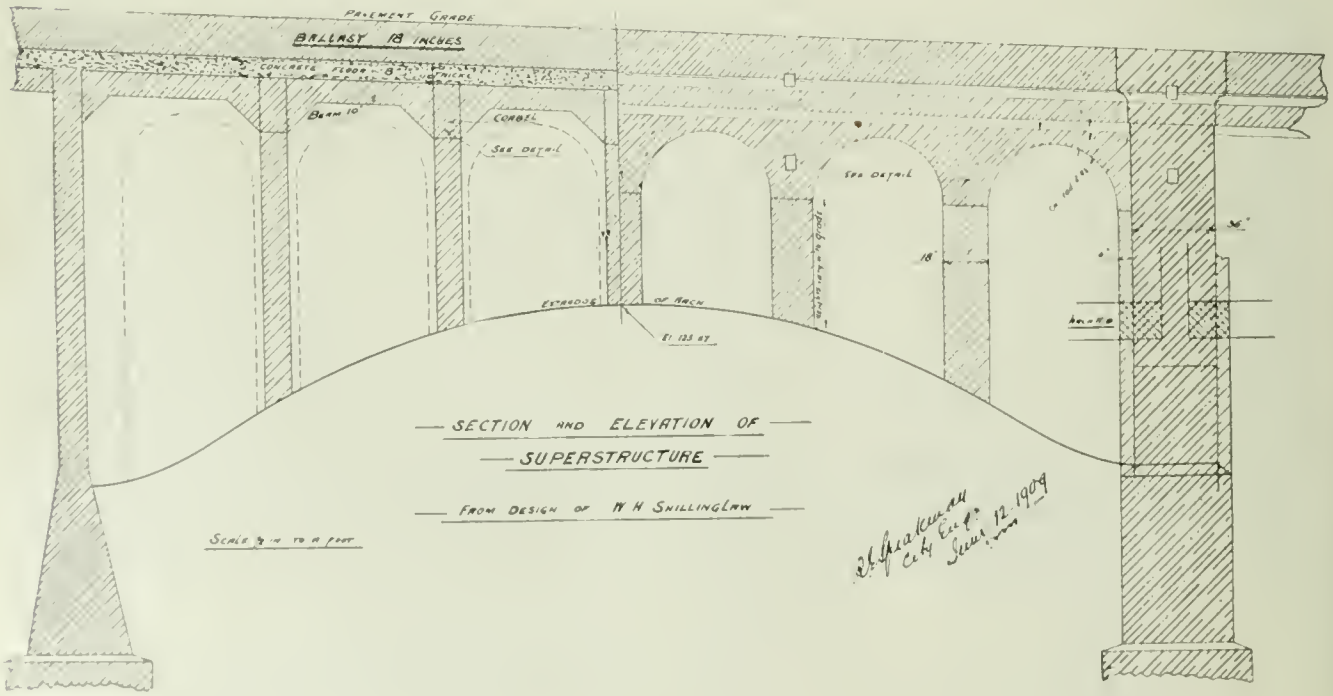
The dead load, including the weight of the bridge, and a reinforced concrete floor with creosoted wood blocks.

A concentrated load as follows:—

A 40-ft. electric motor car weighing 30 tons on four axles followed by a 40-ft .trailer weighing 20 tons on four axles.

Also for a traction engine weighing 15 tons on two axles.

The loading for reinforced concrete approaches is the same as the steel superstructure.



THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## THE CANADIAN SENATE AND RIVERS POLLUTION.

"No person shall throw or deposit, or cause or permit to be thrown or deposited, any sewage, offal or refuse, animal or vegetable matter of any kind whatsoever, into any river, stream or other water, any part of which is navigable, or which flows into any navigable water."

The above is the wording of a clause in a bill which recently received its second reading in the Senate at Ottawa.

If this Bill becomes law it will be the first acceptance by the Dominion of Canada of State responsibility in guarding the purity of Canadian waters.

The Provincial Government have in part shown some awakening to the necessity of prevention of stream pollution, but it is felt on every hand that the recognition of the principle by the Dominion Government will go a long way to strengthen the hands of the Provincial Governments in local legislation.

The Ontario Public Health Act, 1897, enacts Section 30, para. (6): "No sewage, domestic or factory refuse, excremental or other polluting matter of any kind whatsoever, which, either by itself or in connection with other matter, corrupts or impairs, or may corrupt or impair, the quality of the water of any source of public supply for domestic use in any city, town, incorporated village or other municipality, or which renders, or may render, such water injurious to health, shall be placed in or discharged into the waters, or placed or deposited upon the ice of any such source of water supply," . . . "nor within such distance thereof as may be considered unsafe by the Provincial Board of Health," . . . "and any person who shall offend against any provision of this section shall, upon summary conviction, be liable to a penalty of not more than $100 for each offence, and each week's continuation after notice."

The weakness of the above provincial clause lies in the granting of power to the Board of Health to say whether pollution of the water, say, one hundred yards or one hundred miles from the source of water supply intake constitutes a breach of the Act. The meaning of this Act is literally that it may in cases prevent a direct pollution of an individual water supply, but it is not intended to generally prevent stream and lake pollution.

As an instance of the working of the Act we have the case of Toronto, where the water supply is drawn from Lake Ontario. It is at present proposed to empty the whole of the crude sewage, absolutely unpurified or unsterilized apart from the removal of from 60 to 70 per cent. of the grosser solids, into the lake at a point about three miles from the water intake. This principle has been accepted by the Ontario Provincial Board of Health, apparently on the supposition that the point of sewage discharge is removed a sufficient distance from the water zone from which the domestic supply is drawn.

Now, the separating distance may be sufficient—we would not like to dogmatize either way. In last week's issue we published some valuable data upon the currents affecting the lake in this particular quarter, which appeared to show that the general tendency of water movement was from west to east under normal conditions, but under wind conditions the water movement was controlled by the direction of the wind. We certainly would not like to say that the water supply would never under any circumstances be affected by the sewage discharge; and it also appears that the Provincial Board of Health are also not quite certain on this point either.

The Board of Health, while allowing unpurified sewage to enter the lake, also insist that the drinking water be filtered by sand treatment, in order to guard against any chance of sewage contamination.

Where the principle of the Ontario Act appears to us to fail entirely is that it is operative only as it may, in the judgment of a few medical men, constituting a Board of Health, damage some one particular water supply. **The Broad Principle of Pure Water in Canadian Lakes and Streams is Not Recognized.**

Where the principle of the Act proposed by the Senate appears to us to be far and away more efficient than the Ontario Act is in the recognition of the broad principle of guarding from pollution all rivers, streams or other waters, either navigable or flowing into navigable waters.

We wish every success to the proposal of the Senate. The adoption of the principle as a Dominion law that it must be held illegal to pollute nature's water supply will in the end save this country from great future expenditures of money in rectifying negligence, as is so well illustrated in the older countries at the present time, when they are at their wit's end in devising methods and facing enormous monetary outlays in attempts to reclaim waters from the open sewer conditions into which they have been allowed to drift.

Saskatchewan is at the present time putting a Bill through legislative routine to guard and keep pure their water supply sources. That Government will be encouraged by the progressive action of the Dominion Senate. The recognition by law of the conservation of natural resources is always slow, and there will be plenty of kickers of the purely utilitarian school, who cannot recognize either "Godliness" or "cleanliness" when placed in the balance with the "almighty dollar."

In connection with this question of the prevention of pollution of natural waters, we publish in this issue in part an interesting paper, read the other week before the Royal Sanitary Institute, upon the "Quality of

Sewage Effluents in Relation to Standards," by Gilbert John Fowler, D.Sc., F.I.C. Mr. Fowler is superintendent and chemist of the Manchester Corporation Sewage Works. He gave much valuable evidence before the British Royal Commission on Sewage Disposal, and is recognized all the world over as an eminent authority on sewage disposal matters.

## THE QUALITY OF EFFLUENTS IN RELATION TO STANDARDS.*

By Gilbert John Fowler, D.Sc., F.I.C.

At the outset it will be well to define the scope and point of view of the present paper, so as to limit the discussion within reasonable bounds. In the first place, it is assumed that rigid and universally applicable standards are impracticable. In the writer's opinion it is of the greatest importance, in view of the large sums of money which authorities must spend on works of sanitary improvement in many directions, that every effort should be made accurately to ascertain the conditions surrounding any effluent discharge in any given instance. It may be that unnecessary expenditure in the endeavor to reach an uncalled-for standard of purity may cripple the resources available for more needed reform in other directions. In saying this, one is, of course, well aware that many authorities fall far short of adopting reasonable and practicable means for the purification of their sewage. On the other hand, the natural zeal of those responsible for the treatment of the sewage may cause large sums to be lavished on the attainment of results which are more than the situation really calls for.

In this connection the following paragraph 30 of the original Interim Report of the Royal Commission, issued in 1901, may usefully be quoted:—

"We consider it of the utmost importance that the simplest possible means should be provided for adequately protecting all our rivers, and we are further of opinion that it will be desirable, probably for some time to come, that scientific experiments should be carried on in order to ascertain all the real dangers of pollution, against which they should be protected.

"In the present state of knowledge, and especially of bacteriology, it is difficult to estimate these dangers with any accuracy, and it seems quite possible that they should be either exaggerated or undervalued according to the predisposition of those who have to deal with them. An authority, guided by medical considerations, might not unnaturally be inclined to insist on a degree of purity which may ultimately prove in certain cases to be uncalled for, while another authority, with its mind fixed upon economy, might shrink from taking essential precautions."

In the second place, the present paper is not concerned to consider the rival claims of well-known methods of sewage treatment. Any suggestions which may arise are confined to dealing with the effluent as it leaves the filtration works and before it reaches the stream. The subject for discussion, therefore, falls under two heads:—

1. The actual chemical significance of the various chemical tests at present made use of by various rivers authorities for estimating the quality of effluents, with a special reference to the tests suggested by the Royal Commission.

2. The effect which certain effluents, which may comply with some, at any rate, of these standards, may have upon the streams into which they flow.

Taking these subjects, then, in order:—

### 1. The Chemical Meaning of Various Standard Tests.

The chemical tests which are used in estimating the purity or otherwise of an effluent are, speaking generally: The amount of oxygen absorbed from permanganate; the incubation test; albuminoid ammonia; nitrates; suspended solids; and the rate of absorption of dissolved oxygen.

One of the first questions which arise in judging of the meaning of analytical figures is whether a sewage is weak or strong; thus, for example, an 80 per cent reduction of impurity, measured by albuminoid ammonia, with a sewage of original strength of 1 part of albuminoid ammonia per 100,000, would give an effluent with an albuminoid ammonia of 0.2 parts per 100,000. If the original figure for the sewage was 0.5, the effluent would be 0.1, which would be, for instance, within the limits of the Mersey and Irwell Joint Committee. Assuming that the sewages differed only in strength, it may be taken that the character of the organic matter remaining in the effluent is the same in both cases, and thus is of equal effect from a pollution point of view, although superficially one effluent is twice as bad as the other. It has, indeed, been argued by Dunbar and Thummy on the Continent that after a certain percentage purification has been attained the residual organic matter is so altered in character as to be inoffensive.

On the other hand, it has been pointed out to me by a responsible chief inspector that the effect of the two effluents on the stream is not identical, owing to the greater volume of diluting water carried by the weaker sewage. This is a point which deserves discussion, especially in relation to the development of growths, which is the chief subject matter of the later part of this paper.

The question of suspended matter raises several points of importance. As Mr. Thompson pointed out at Leeds, much depends upon the length of time elapsing between the taking of the sample and its actual analysis. Many effluents, especially those containing iron salts, while free from visible suspended solids at the time of sampling, are capable of yielding considerable deposits on standing. The "clarification test," which was described by the present writer in a paper before the Society of Chemical Industry, 1908, affords a means of approximately estimating the character and amount of this potential deposit. It may vary very much in different classes of sewage, and in the same sewage on different days of the week. Thus, for example, the sewage of Wakefield, which has recently been submitted to thorough investigation, contains the greater part of its organic matter in the colloidal state, owing to the amount of wool-washing refuse present. The precise reverse is characteristic of Manchester sewage. Again, those who are familiar with small sewage works will have noticed the greater opalescence of the effluent on washing days; in fact, there is evidence to show that the colloidal matter in an effluent consists largely of metallic soaps.

The trade effluents in the sewage naturally greatly affect the meaning to be attached to the different analytical figures. Mention has already been made of Wakefield. Even after the removal of the grease, the residual organic matter from the wool contains a high proportion of organic nitrogen, which there is reason to believe oxidizes much more slowly than the nitrogenous organic matter of ordinary sewage.

What has been said with regard to Wakefield sewage applies even more noticeably to the sewage of Bradford. It

* Extracted from paper read before the Royal Sanitary Institute.

is to be expected, therefore, that effluents from such towns will contain high figures for albuminoid ammonia, which are not derived necessarily from "excrementitious matter."

In the case of Manchester, the albuminoid ammonia figure, and to a greater extent the oxygen absorbed figure, is affected by trade effluent, more particularly by phenolic compounds and by sulpho-cyanates contained in the ammonia recovery liquors, which are turned into the sewers in large quantities by the gas works, and by manufacturers, who work up the liquors from other towns.

It is the custom of the rivers authorities in the northern manufacturing centres to adopt different standards, in the case of manufacturers' effluents, from those employed in judging the effluents from sewage works. Provided suspended solids are removed, much higher figures are allowed for oxygen absorption and for albuminoid ammonia in the former than in the latter case.

It is no doubt rightly considered that, apart from the inherent difficulties of treatment, manufacturers' effluents are less dangerous—from the point of view at any rate of producing nuisance—than the effluents from sewage works. It should, however, easily be possible to determine within limits what proportion, say, of the oxygen absorbed figure is due to trade refuse, and what proportion to sewage proper, by comparison—e.g., with purely domestic sewage of corresponding strength or by special methods of analysis. Thus it has been possible, by means of the "clarification test," to show that Manchester sewage contains an abnormal proportion of oxidizable matter in true or "crystalloidal" solution, which diminishes at times when ammonia recovery liquor is not present in the sewage.

All these and other difficulties in interpretation of the various analytical figures made use of as provisional standards, are sought to be overcome by the two simple tests suggested by the Royal Commission which may usually be here mentioned in full. The Royal Commission state that an effluent would generally be satisfactory if it complied with the following conditions:—

(1) That it should not contain more than three parts per 100,000 of suspended matter; and (2) that after being filtered through filter paper it should not absorb more than (a) 0.5 parts by weight per 100,000 of dissolved or atmospheric oxygen in twenty-four hours; (b) 1.0 part by weight per 100,000 of dissolved or atmospheric oxygen in forty-eight hours, or (c) 1.5 parts by weight per 100,000 of dissolved or atmospheric oxygen in five days.

In connection with the suspended matter determinations Mr. Thompson has pointed out the differences already mentioned due to the presence of colloidal matter, apparently fearing that the estimation of suspended solids is likely to be unfairly high unless the sample is analyzed at once after collection. The danger would seem to be rather in the other direction. On the other hand, the filtration through paper, which is recommended, is likely to cause retention of colloidal matter, and consequently diminution in the amount of dissolved oxygen ultimately taken up.

It might be suggested that the dissolved oxygen should be determined after the sample has been allowed to settle, say, for one hour. In the case of a bright effluent from a percolating filter this would afford time for the humus to deposit, the absorption of dissolved oxygen could then be determined in the decanted liquid, when, if colloidal matters were present, the oxygen absorbed by these would be taken into account. It may be objected that this method is less precise than the one given by the Royal Commission, but with reasonable care it would appear likely more truly to indicate the real nature of the effluent.

Mr. Thompson's suggestion that one determination of the dissolved oxygen absorbed after twenty-four hours would be sufficient would certainly result in saving of time, and probably in the majority of cases would be adequate. In presence of antiseptic substances, or of difficult oxidisable matter, a possibility of error might arise. On the whole, however, the Royal Commission tests, especially if slightly modified as suggested, should distinguish between weak and strong sewage, and generally enable a fair conclusion to be drawn as to the probable effect of the effluent upon the stream into which it flows.

The test is ultimately based on the careful researches of Adeney, who has shown that when organic matter of various sorts is submitted to the action of dissolved oxygen in presence of bacteria oxidation takes place in two well-defined stages, viz., the oxidation of carbon to carbon dioxide, and of nitrogen to nitric acid. It may, however, be questioned whether this sequence, which holds for mixtures of polluted matter and water containing an excess of dissolved oxygen, exists equally under the conditions of purification of a sewage works. There are reasons for thinking, in the writer's opinion, that, e.g., in high-speed percolating filters the ammonia in the sewage may be oxidized in large measure to nitrates, while the more resistant organic matter is far from completely attacked.

In the case of contact beds, moreover, the first portion of the discharge is certainly less well ozidized than the last drainings, and, while the average effluent may fulfil all requirements, a portion, at any rate, of the albuminoid ammonia may be due to less perfectly oxidized organic matter. Although this may not absorb a great amount of dissolved oxygen, it may make its presence felt in the encouragement of certain kinds of growth which become apparent at the outlet of the filters, or in the stream below the effluent outfall.

This leads up to the second part of this paper, viz.:—

**2. The Effect of Effluents upon Streams.**

Just as the efforts of what may be called the chemical era of sewage purification were directed to clarification, with little regard to the chemical composition of the clarified liquid, so the activity of the last decade has been in the direction of the mineralization of dissolved organic matter, with production—e.g., of nitrates, without much consideration of the possibilities of re-absorption of these products into the cycle of organic life. Where final land treatment is resorted to these mineral constituents are usefully absorbed. In the majority of cases, however, such effluents, if non-putrefactive, are allowed by the Rivers Board to pass into streams without further treatment. If thorough mixing takes place with a large body of water, no detrimental effects are, as a rule, observable, even if purification is not carried to the fullest possible extent.

On the other hand, cases are accumulating where effluents, satisfactory from the point of view of mineralization of the greater part of the organic matter, and consequent non-putrescibility, are yet capable of causing considerable growth of organic life, which subsequently may enter into decomposition with production of nuisance. The mineralized matter has, in fact, again become organic.

A classic instance, is of course, Belfast, where the researches of Dr. Letts have shown that the seaweed ulva latissima is capable of absorbing nitrogen, not only from crude sewage, but also from the ammonia and nitrates present in effluents from ordinary filter beds. The subsequent decomposition of the ulva is the cause of very serious nuisance, owing to the development especially of sulphuretted hydrogen. . . .

(To Be Continued.)

## PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

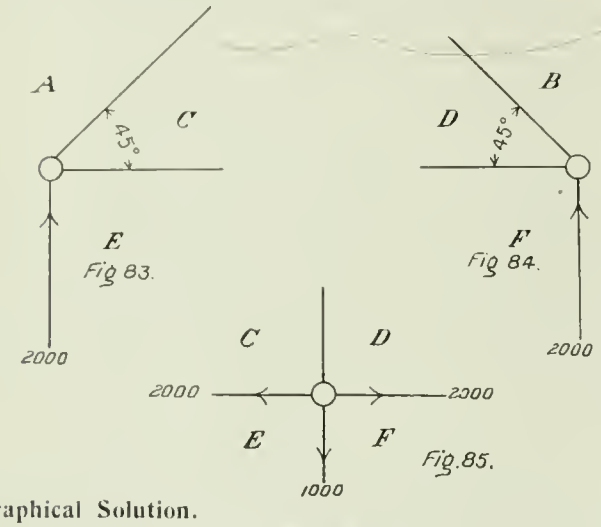
(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

Consider the forces acting at the point EFDC. The condition of affairs is represented in the Statical Diagram (Fig. 85).

$$\Sigma Y = Y_{EF} + Y_{FD} + Y_{DC} + Y_{CE} = 0.$$
$$-1{,}000 + 0 + DC + 0 = 0.$$
$$DC = 1{,}000.$$

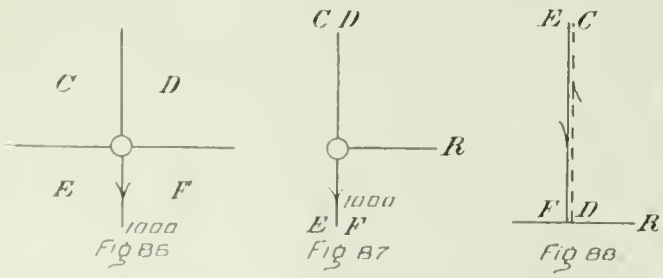
From the positive result it is seen that the $Y_{DC}$ is positive. DC, therefore, acts away from the point; i.e., the member DC is in tension 1,000 pounds.




**Graphical Solution.**

**Consider the forces acting at the point EFDC,** represented in the Statical Diagram (Fig. 86). Since there are three unknown forces in this case, it is seemingly impossible to construct the Vector Polygon for the set of forces. However, **because FD and CE have the same lines of action, their resultant must act in that line.** Replace FD and CE by their resultant as indicated by R, Statical Diagram (Fig. 87). How this resultant acts is as yet unknown, but, as will be seen, this is of no importance.

Construct the Vector Polygon for the forces shown in the Statical Diagram (Fig. 87). Draw EF (Fig. 88) to represent the known force EF (Fig. 87). Then, from F (Fig. 88) a line is drawn to represent the known direction of R (Fig. 87). Now, since the set of forces

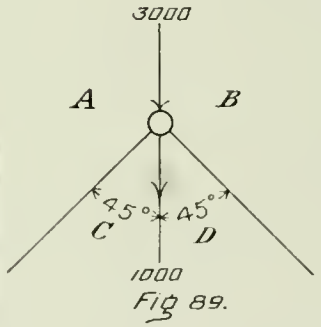


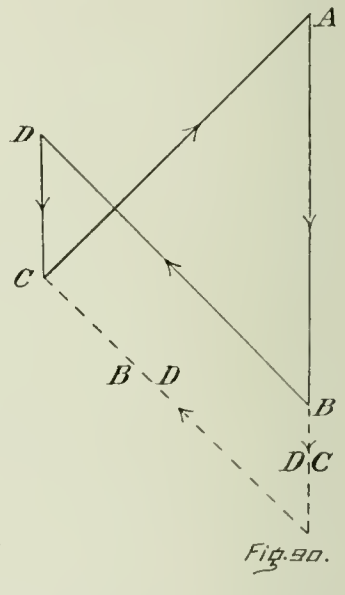

being considered is in equilibrium, we know that from some point in the line drawn to represent the direction of R, another line must be drawn to represent the direction of CD (Fig. 87), and also pass through E (Fig. 88), thereby closing the Vector Polygon. It is evident that such a line will coincide with EF (Fig. 88). To avoid confusion, the line representing DC, which would coincide with EF, is shown dotted to one side of EF. The force DC is seen to be an equal and opposite force to EF; i.e., it acts away from the point. The member DC is, therefore, in tension 1,000 pounds.

**Consider the forces acting at the point ABDC,** Fig. 89 being the Statical Diagram representing the condition of affairs at this point.

AB (Fig. 90) represents the known force AB (Fig. 89), due to the load of 3,000 pounds. Referring to Fig. 89, it is seen that an unknown force intervenes between the force AB and the next known force DC. It will, therefore, be impossible to use Bow's Notation throughout in constructing the Vector Polygon. **Whenever this notation cannot be applied to a line representing any particular force, the line will be shown dotted and the letters designating the force placed beside the line.**

From B (Fig. 90) a dotted line is drawn to represent the known force DC. Now, since the forces under consideration are in equilibrium, their Vector Polygon must close, and it must be closed by lines drawn to represent the directions of the unknown forces BD and CA. Therefore, from the termination of the dotted line drawn to represent DC, a dotted line is drawn to represent the direction of the force BD, and from A is drawn another line to represent the direction of the force CA. These last two lines intersect at C, and it is seen that Bow's Notation applies to the line representing the force CA. This line is, therefore, drawn in full. The Polygon should then read: AB, DC (dotted line), BD (dotted line), and CA.




Having fully determined the unknown forces, it is now possible to go back and construct a Vector Polygon lettered throughout with Bow's Notation.

From B (Fig. 90) draw the full line BD equal in length and parallel to the dotted line representing the force BD. If D be joined to C, the line DC should then be equal and parallel to the dotted line representing the force DC. This new polygon, which will represent fully the forces acting at the point being considered, reads: AB, BD, DC, and CA.

(Continued on Page 645.)

## PRODUCER GAS PLANT PRACTICE.*

Michael Chapman, A.M.I.E.E.†

I shall not attempt to more than very briefly touch on the history of producer gas. You have probably heard it so often that, although a fascinating story, it will not bear repetition.

Sir William Siemens first utilized producer gas in connection with steel furnaces and industrial application of gas firing, and actually previous to 1878 attempted to utilize it in gas engines. He failed for two reasons:—

1. The gas made in his producer was too poor in quality to be fired by engines using the compressions at that time available.

2. He had not solved the problem of cleaning the gas.

Mr. T. Emerson Dowson, in 1878, secured a patent covering a producer, which overcame the first mistake made by Siemens by the addition of steam to the air which passed through the incandescent coal, and so raised the quality of the gas from 80 B.t.u. to 130 B.t.u. per cubic foot.

The second mistake was overcome by a compromise. He confined his plant to the use of fuels free from tar, such as hand-picked anthracite and gas-house coke. This plant was the first really serviceable equipment for supplying producer gas to gas engines.

I will now give you the chemical constitution of producer gas and a short description of its manufacture, which is commonly applicable to all the different styles of plants put on the market by the different well-known makers.

The chemical reaction is as follows:—

(1) $C+O_2=CO_2$. (2) $C+CO_2=2CO$. (3) $C+H_2O=H_2+CO$.

These reactions take place in the order given, the first at the bottom of the fire, the second in the hottest part, about seven inches higher up.

In order to obtain the above results a temperature of about 500° C. at the bottom of the fire and 1,000° C. a little higher is necessary. In short, producer gas is the result of passing a mixture of steam and air through incandescent fuel, and the quality of the gas obtained depends on variations in the process.

I shall not touch on the two other gases chiefly met with, namely, Town's gas and water gas, except to say that the first is made by the destructive distillation of coal in a closed retort, and the second by blowing steam through incandescent fuel, with decomposition of the same, the incandescence being produced by combustion of the fuel with an air blast, and the blowing and steaming periods being intermittent.

### Producer Gas.

The gas of which we are talking can be roughly described as being made by one of three processes:—

1. By the piston of a gas engine aspirating the gas from a producer direct without any intermediate storage or gas-holder. The resultant gas is known as suction gas.

2. By the action of a roots or other type of blower placed between the producer and the point at which the gas is to be used. The blower draws the gas under less than atmospheric pressure and delivers it under pressure. This is called a suction pressure plant.

3. By the action of a positive blower forcing air and steam through the producer and delivering the resultant gas under pressure to the point required. This is called a pressure plant.

It becomes the first duty of the engineer laying out a power plant with gas engines as prime movers to ask himself the following questions:—

1. Shall the plant be of the suction, suction pressure, or pressure type?

2. How is it possible to obtain the maximum benefit from the use of producer gas in Canada where, during six months of the year, heating in a factory is required?

Now, one of the great advantages that producer gas offers over steam or any other source of power is its applicability to singeing, grazing, melting, etc., and it is this side of the problem which has been neglected in this country, and has held back its rapid development. Also, every factory owner is obsessed with the idea that with a gas engine it is impossible to utilize the exhaust for heating purposes as in a steam engine, and many are the orders for gas plants that have been lost in this way, owing to the gas engineer being nonplussed when asked if he could undertake to heat the factory in the winter from the exhaust.

The day when this remark regarding factory heating held good is over, and I am in a position to say that anyone utilizing 50 horse-power and over on a reasonably steady load can by the use of a properly designed heater obtain during the day nearly as much heating effect from a gas plant as from a steam system, the difference being purely in the efficiency of the gas engine and the steam engine and the amount of heat wasted in the two systems, which, of course, is less in the gas engine than the steam engine.

Some rough rules to guide the engineer in settling on the type of plant to be employed are as follows:—

1. For a straight power proposition, such as the driving of a factory, I would recommend a plain suction plant.

2. Where there is the chance of applying gas to brazing, etc., a suction pressure plant.

3. Where several engines are running at different points on a violently fluctuating level, a pressure plant.

I propose now to mention some of the troubles that are met with in actual practice, troubles which have their origin in causes ridiculously simple, and yet cause the engineer many moments of worry until he knows the vagaries of producer gas as thoroughly as the steam engineer knows those of steam. I shall take the instance of a plain suction plant running an engine on a steady load. That is the simplest problem you can have, the engine being a single cylinder hit-and-miss Otto cycle engine.

Starting from the time the man blows up his fire, he is supposed to have good gas and his engine under way in two minutes. Suppose he cannot get any gas, and the time for starting the factory arrives, he asks himself what is the matter, and generally loses his head, blaming the producer, the state of irritation being increased by the monotonous job of grinding the fan. What he should do is this:—

1. See that water is in his boiler. If there is not any, he is making air gas only, and the addition of steam will cure the trouble.

2. Feel at his test-cock if there is plenty of pressure, and look at his gauge, an instrument which is hardly ever installed, and yet tells such a lot to an intelligent operator. If there is no pressure at the cock and his fan runs easily, and yet the gauge registers two or three inches, he will know that the gauge which covers the test-cock is blocked, and that by renewing it he will probably find good gas, and plenty of it. This simple mistake has nonplussed many good men at times.

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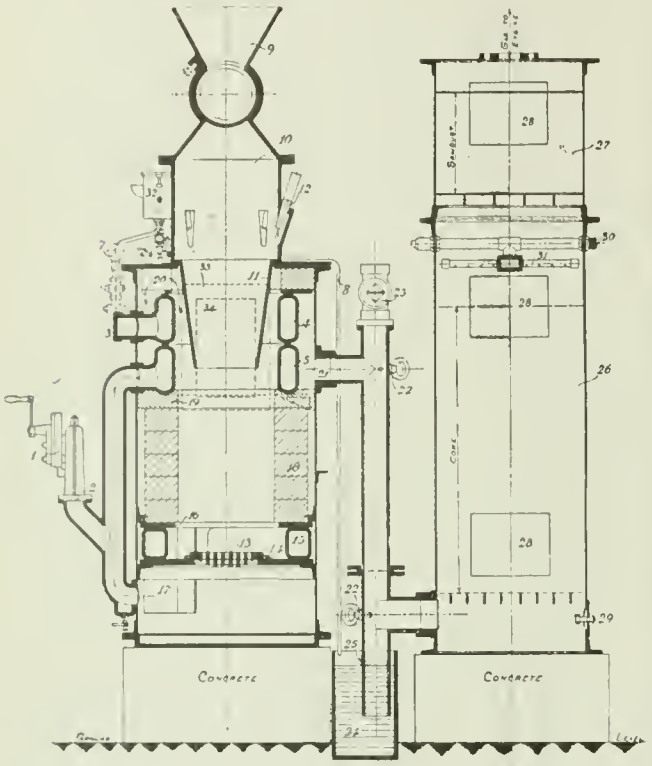
* Paper presented at the Engineers' Club of Toronto, November 18th, 1909.

† Of Chapman & Walker, Limited, 69 Victoria Street, Toronto, Ont.

3. If his gauge registers a pressure a great deal lower than usual and the pressure at the test-cock is small, he will know there is an obstruction either in the producer from clinkers or in the piping from accumulation of dust, or if the plant is just being started for the first time, from someone having left waste in one of the pipes. This trouble will be accompanied by a hard feeling of back pressure to the grinding of the fan. He should first poke down his fire, and be sure that the producer is not solid with clinker, and then, after being sure that there are no doors left open or leaking joints, he must search for the obstruction in the pipes.




**Key to Sectional Drawing of Suction Gas Plant.**

1, Hand Fan; 2, Damper Valve; 3, Air Inlet; 4, Vaporizer; 5, Vaporizer; 6, Suction Pipe Auto. Feed Tank; 7, Water Inlet to Vaporizer; 8, Overflow from Auto. Feed; 9, Feeder; 10, Hopper; 11, Hopper Bell; 12, Poker Hole Plugs; 13, Firegrate; 14, Firegrate Support; 15, Superheaters; 16, Firebrick Support; 17, Firedoors; 18, Firebrick; 19, Fireclay; 20, Gas Passage; 21, Gas Outlet; 22, Cleaning Holes; 23, Blow-off Cock; 24, Seal Pot; 25, Overflow from Seal Pot; 26, Coke Scrubber; 27, Sawdust Scrubber; 28, Doors; 29, Cleaning Door; 30, Water Spray Feed; 31, Sprays; 32, Automatic Feed to Vaporizer; 33, Vaporizer Cleaning Door Frame; 34, Vaporizer Cleaning Door Cover.

4. He may get gas at the producer test-cock and none at the engine. In this case he should compare the gauge which is placed before the scrubber and that placed after it. If the difference is excessive, he knows that there is an obstruction in the scrubber, or that some joint is leaking badly. The only way to remedy the first trouble is to repack the scrubber, but it is an unlikely trouble, unless the quality of coal requires big sawdust scrubbers.

5. Leaking joints are the greatest cause of trouble in suction producers, and every joint should be most carefully made, and the complete plant given a smoke test before starting.

6. If the gas is obtained quickly and the engine goes off splendidly and then dies away, you know that one of the following things has happened:—

I. The doors may be leaking and too much air being admitted before the point of chemical reaction.

II. The hopper or portion of the plant after the point of reaction may be leaking, so diluting the resultant gas.

III. The water supply to the boiler may be affected.

IV. Air may be leaking up the brickwork lining without going through the fire. This is the worst and most insidious form of trouble, but with good erection should never occur.

The troubles I have so far given are mostly those due to lack of intelligence, want of attention, or faulty erection.

Now I shall come to troubles due **to fuel,** and first of all shall confine myself to anthracite and coke.

An analysis generally applicable to anthracite is:—

| | Carbon. | Hydrogen. | Nitrogen. | Sulphur. |
|---|---|---|---|---|
| Welsh anthracite .... | 89.17 | 3.50 | 0.91 | 0.96 |

| | Oxygen by Difference. | Moisture. | Ash. | B.t.u. per lb. |
|---|---|---|---|---|
| Welsh anthracite ... | 1.56 | 1.78 | 2.12 | 15,224 |

You will see from this that the percentage of hydrocarbon is small, so we have to take very little precaution against tar, and, therefore, the plant is simple.

The analysis of gas-house coke is:—

| | Carbon. | Hydrogen. | Nitrogen. | Sulphur. |
|---|---|---|---|---|
| Welsh anthracite coke | 88.64 | 1.37 | 0.99 | 0.63 |

| | Oxygen by Difference. | Moisture. | Ash. |
|---|---|---|---|
| Welsh anthracite coke ..... | 0.60 | 5.60 | 2.17 |

Again, volatile matter is small, and, therefore, the same plant is applicable, but just in proportion to the difference of the B.t.u. of the fuel, so the plant for coke has to be larger than that for anthracite; and here I would like to warn you against blast furnace coke, the product of coke ovens. It is not a clean fuel, and resquires special cleaning apparatus, although certain parts of the coke which comes from the bottom of the Beehive oven form the purest fuel you can get, but commercially, for producer work, it is dangerous to attempt to use it in a plain suction plant.

Now, there are anthracites and anthracites, all differing little in their analysis. They have deceived many engineers, who have not been to the trouble and expense of treating them in large bulk samples, and I propose to mention the chief causes of their trouble:—

1. First comes the fact that a large demand for a product of any kind creates a special quality of that product treated in a special way to make it suitable for its special market.

In England and on the Continent, for instance, producer plants have been in use for many years. The number of horse-power at work is enormous, and there the demand for anthracite for this purpose became so great that the coal owners, seeing a good field for their product, took the trouble to very carefully supply what the producer maker demanded, namely, an anthracite, washed, freed from slate by hand-picking, and graded very carefully in sizes. The result is that, weight for weight, English anthracite, as sold for producer use, has more B.t.u.'s than Pennsylvania anthracite, which is bought in Canada, and the ash resulting from combustion is far less, which means:—

1. That to develop the same horse-power in this country you must have a larger plant.

2. That in order to get rid of the ash accumulating on the grate you must, for ease of handling and as a labor-saving device, supply a Shatsing or Rotating grate. The

latter appeals to me most from my own experience, and makes the fire settle down more solidly after its use, also keeping the bricks freer from clinkers.

II. The first fact I referred to was purely a commercial coincident, due to local circumstances, and easily remediable if taken in time. The second is the fact that the incombustible constitutent of Pennsylvanian coals fuse to clinker at a lower temperature than do those from Wales, and, therefore, we **must** in this country keep the temperature down to a proportionately low level, depending on these critical temperatures. You will see that a larger producer will, as it happens, effect this result without further attention. A further fact for which I have not found a really satisfying reason is that an increase in the height of the producer improves the working of producers with Canadian fuel immensely.

I would like to hear a few suggestions on this subject. It is not as if the proportion between height and diameter had been kept constant. The height for Canadian anthracite is considerably more in proportion to the diameter than with English anthracite. To sum up all my experience and the remarks previously made, I would specify for a successful producer on Canadian anthracite:—

1. That the diameter and height of the plant should be ample.
2. That gauges should be installed, and intelligently used.
3. That the hand-fan should be motor-driven.
4. That all bends should be cleaning bends.
5. That the water supply for the boiler should be under automatic regulation, so that the steam generated should be in strict proportion to the load.
6. That all test-cocks be fitted with gauze, applying Davy's well-known principle to prevent explosions.
7. That all joints be designed so that possibilities of leaks are reduced to a minimum.

Given all these points and handled by an intelligent man, a suction anthracite or coke plant is the simplest and most efficient equipment in conjunction with a gas engine that can be obtained.

Now, anthracite and coke are all right as fuels, and, in fact, ideal, but, like all things ideal, they are expensive, and the more people realize their possibilities in producers the more expensive will they become, so that it has been the object of every up-to-date firm in the business to put on the market a plant which will use bituminous coal as well. The company with whom I am associated has been grappling with this problem for years, and now they have plants of 50 horse-power up to any size for this class of fuel, arranged again on the three principles of suction, suction pressure, and pressure.

The use of bituminous fuel in large plants has been solved for quite a number of years by such firms as Crossley Bros., the Power Gas Corporation, etc., and the horse-power of these plants already in use runs into hundreds of thousands, and is constantly increasing, but there has, till the last few years, been a disposition not to build them much below three or four hundred horse-power.

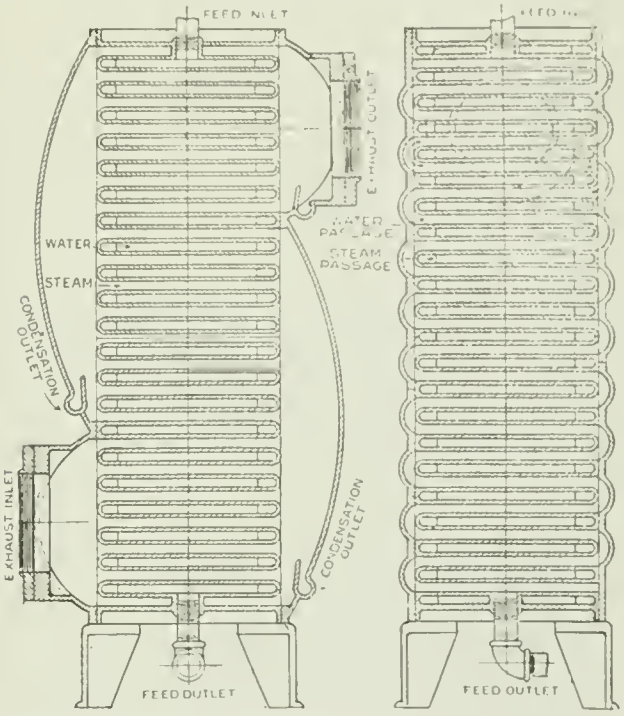
In the solution of this problem of using bituminous fuel there have been two schools of thought, and nearly everyone has started by being a strong adherent of the one, and, after thinking they had solved the problem, have gone over to the other, which, so far, has proved the only truly satisfactory system.

The first idea was to make gas, either in one producer and pass those gases through a second producer, which was maintained at a high temperature, and there convert the volatile and tarry constitutents into a permanent gas, or to carry out practically the same process in one producer by having two zones: the one a gas-making zone, the other a zone at a high temperature, for what we call cracking the tarry matter into permanent gas, so adding the heat value of these constituents to the sum total of B.t.u. of the gas, and at the same time removing all chances of trouble from tar on the engine piston or in the pipe system.

The idea is fascinating and apparently simple, but in practice it does not work, and you will find, as I have said, that when you inspect such plants they have always in addition a number of special washers to take out the tar, which was supposed to be removed by the second producer, or double zone system.

The second process is to combine with your bituminous producer a slow-speed centrifugal water-fed fan, which intimately mixes the gas with a water spray and removes all particles of tar.

This tar extractor is a simple machine, and by its use in combination with their bituminous producers the makers can supply plants as small as 50 B.h.p. to use bituminous




**Exhaust Steam Heater**

coal, anthracite, coke, and, with modification, wood, sawdust, and peat, thus placing customers in the position of not being bound to one source of fuel supply.

When I say bituminous plants, I want to make it clear that I do not mean that one can use such coal indiscriminately.

To a producer gas engineer, bituminous fuels are sharply divided into those that are called "caking" and those that are called "non-caking," or free-burning, and, although in actual fact these fuels are generally distinctly different in their behaviour under certain tests, cases occur where it is difficult to say to which class they belong, and then a test with a bulk sample under actual working conditions is the only reliable data on which to depend.

Roughly speaking, the practical engineer can, by a test, find whether a fuel is caking or non-caking, but before I give you the test, I will give a rough definition of the two terms:—

1. A caking fuel is a fuel that, when heated, does not retain its original shape, but runs together into a homo-

geneous mass, becomes pasty, and, as the volatile matter is expelled, yields a solid mass, preventing the passage of the gas.

II. A non-caking fuel is a fuel that, when heated, approximately retains its original shape and then crumbles into ash.

**Test for Caking Coal.**

1. Powder the fuel very finely in a mortar.

2. Place in a small crucible a teaspoonful of the powder.

3. Place a loose-fitting lid on the crucible and heat over a spirit lamp.

4. Heat until all the gas has ceased to come off.

5. In order to test this apply a match above the crucible and around the edge of the lid, when probably a flame will spring from the crucible and burn for a few seconds.

6. In case no gas is available, heat the crucible for five minutes.

7. Allow the crucible to cool naturally.

8. Turn out the contents.

9. If the residue is a compact, homogeneous mass, you will know that it is coke and the fuel is caking.

10. If the residue comes out fairly loose, you will know that the coal is non-caking.

11. Most caking bituminous coals give a yellow flame. This generally indicates tar.

12. If the sample swells very much and gives a soft, porous coke, it is probably suitable, and at any rate worth trying.

When a test of this description has been carried out, and if the fuel proves itself non-caking, an ordinary bituminous plant can be installed; if the test is not very distinct in its result, then the only satisfactory action to take is to ship a bulk sample and test it in the factory.

If, however, the fuel according to the test is clearly caking, a very special plant must be installed, with a water-cooled, motor-driven poker This is a complicated plant, and the high first cost is only justified in the case of large installations.

The Wellman-Seaver-Morgan Engineering Co.'s plant, designed by Mr. Fraser Talbot especially for using caking coals, a vertical rod passes down the centre of the producer, which is of the water-bottom type, and carries two radial arms, which are placed at different angles.

The rod and arms are water-cooled, and rotate slowly, about once in ten minutes, at the same time having a vertical motion.

In this paper I have briefly tried to touch on the practical side of producer work as applied to gas engines, and have purposely left out gas engines, as both subjects are so large that it is impossible to do justice even to the one in the short time at my disposal.

There are, however, one or two practical points which make the difference between success and failure, satisfaction and disappointment in the combination of a producer with a gas engine, which truly come under the heading of the latter, and which I propose to mention before closing.

The gas engine as generally supplied to-day is either multi-cylinder vertical, or single flywheel single cylinder horizontal, and in the last design, as the sizes of the units grow, the weight of the flywheel increases to a point at which it is foolish, if not criminal, not to supply special gear for placing the engine into its starting position, and afterwards of causing the engine to carry out its complete cycle, and so obtain its own impulses by firing its own gas.

**Barring Gear.**

Some makers supply no means of placing the engine in position on the firing stroke up to as high as 75 horse-power. The result is that you will sometimes see the engineer and probably two or three helpers dragging on the flywheel, to their complete disgust and exhaustion. Other makers have small holes in the side of the rim of the flywheel, and supply a fulcrum and bar. This is better practice, but a poor job, and in this respect there is only one satisfactory equipment, and that is a pinion keyed on to a shaft resting in bearings and supplied with a large hand-wheel, the pinion meshing in teeth cast in the rim of the flywheel.

**Starting Apparatus.**

When an engine is put to work on producer gas, it is given an impulse either by what is known as an explosion starter or by compressed air. The first method consists of pumping a certain number of strokes of a pump, generally fixed to the engine, which delivers a certain quantity of gas into the engine cylinder, a valve is then operated and a certain quantity of air is pumped into the cylinder, so as to make an explosive mixture. The charge is then fired by electric ignition or tube.

Now, this system is a poor one for producer gas, because the quality of your gas at the commencement of operations is not constant, and, therefore, I would not recommend its use except as a standby. The engineer may obtain the right mixture the first attempt; he may try ten times, and, therefore, no one can call it a truly reliable system.

Compressed air from a separate small air compressor set is the ideal practice; failing that, compressed air stored in a receiver by running the engine as a compressor when shutting down, but economy should not be allowed to influence the engineer in these two details. An extra $200 on a plant of 50 horse-power will save the engineer's temper and avoid all delays in starting.

## THE RECONSTRUCTION OF A CONCRETE GAS TANK HOLDER AT KINGSTON, ONT.*

Once more the necessity of care in concrete building has been demonstrated in the case of the concrete tank in connection with the gas plant of the corporation of Kingston, Ont. It has brought up the oft-repeated warning that concrete must be well built. It has demonstrated once more the fact that where care and precaution have been taken concrete is superior to all other materials for most classes of construction work. The general public of to-day are too well acquainted with the properties of concrete to condemn it whenever faulty construction has produced failure. In the case in question those in charge of the city's welfare, after first endeavoring to meet the difficulties by temporary changes and alterations, called for tenders, allowing those who tendered to use almost entirely their own methods of procedure. As a matter of fact, the work was well advanced by the successful tenderers, Messrs. Merrill & Allen, before they finally decided upon the method of waterproofing to be employed. The method of procedure throughout was entirely their own, and in portions experimental, as many difficulties presented themselves throughout the work. That the con-

* Mr. E. B. Merrill, consulting engineer, Toronto, delivered an illustrated address before the Engineers' Club of Toronto in connection with this work.

tractors have been successful may be judged from the notices in local Kingston papers, which speak in the highest terms of the nature of the work and the satisfactory tests which have been made since the work was finally completed. A brief mention of the events leading up to the final reconstruction of the work may be of interest. There was completed during the fall of 1907 a concrete tank and a two-lift steel holder for the Heat, Light and Power Department. The steel holder was constructed by Messrs. Davis & Farnum Co., Waltham,

**Suspension of Tanks, showing One of the Ten Columns.**

Mass. It had a capacity of 150,000 cubic feet. The tank was constructed of concrete by a local contractor under the supervision of Mr. J. M. Campbell, then manager for the Heat, Light and Power Department. In the fall of 1907, before filling tank with water, it received a good coating of coal tar and resin, which adhered well to the walls and bottom. When water was put in it settled as much as two feet in twenty-four hours, or 69,000 gallons per day, and as much as 23,000 gallons per day after being tarred, still a large leakage. In the spring of 1908 the tank was put out of commission and the water pumped out. A general inspection was made, and several bad leaks were located. Mr. Campbell then arranged with the Warren Bitumen Co., of Rochester, to waterproof the interior of walls. This coat consisted of three layers of tarred felt, with a cap sheet, making four ply, all told, with a coating of No. 4 pitch between each layer. Both sides and bottom were thus treated. Then four inches of concrete of a 1:2:4 mixture was placed in the bottom of the tank. The paper sagged out for several inches in places along bottom of walls. It was originally intended to put a layer of three inches of concrete against the paper to hold it to the main concrete wall. This idea was abandoned, and instead a four-inch brick lining against the tarred felt was suggested. The question resolved itself into whether to make the tank watertight or condemn it entirely and build a new one. Several suggestions were made as follows: (1) Take off felt and rack the walls to a rough surface so that a new coating of cement and sand (2 to 1) of ½ or ¾ of an inch in thickness be trowelled on. (2) To take off felt and roughen surface and erect wooden forms, so that three inches of concrete might be placed against the present main concrete wall. (3) Leave paper on and line with brick, (four inches) embedded in cement. (4) Put in steel lining, with a 3-inch flange at bottom, this flange to be covered with a good, strong mixture of concrete. (5) Raise both lifts and blow up present concrete wall and build a new one.

In regard to No. 4, it was considered too expensive, as was also No. 5. Nos. 2 and 3 were thrown out as the space between the holder and concrete was small. It would be necessary to cut off about two inches of the flange or cut away the masonry to allow the laying of brick on the concrete. In the meantime several methods were used to stop the leaks. The driving of a small wrought iron pipe, about ⅛-inch, into wall where leaks were the worst and fill up the other leaking places. Also, the leaks were plugged with clay and mortar. Over this was trowelled on a strong mortar of cement, alum and sand, but this was forced or eaten away. Several loads of manure were scattered upon the surface of the water, and a mixture of three parts of bran and one of cement was put on the water close to the concrete wall to draw it into the openings.

A report made to the Light, Heat and Power Department of the Kingston council by Mr. W. E. McKay, consulting engineer, Boston, during November, 1908, based on the specifications for the tank construction, personal inspection, and information furnished by the Kingston council contains a criticism of the conditions under which the concrete work was built, as well as several details of the specifications. The following is a

**A View of the Interior showing the Crumbled Condition of the Original Wall.**

portion of this report in so far as it deals with the manner in which the concrete work was originally carried out:—

(a) The concrete to be composed of one part cement, three parts of coarse sand, and six parts of broken stone, and that the largest piece of broken stone shall pass through a two-inch ring, and that large stones may be placed in the concrete work.

(b) That the concrete wall is to be approximately two feet thick.

2. The specifications may be adversely criticized in the following details:—

(a) The concrete mixture is not sufficiently rich to insure watertight work; the proportions should be one, two and four, or one, two and a half, and five. The stone should be carefully graded, and all pieces should pass in any direction through a two-inch ring. No large stones should be used.

(b) In the rock the wall was laid without outside forms, and the minimum thickness is stated as eight inches. The rock is stratified, with the joints of varying magnitude between the layers of the rock. Into, and through these openings the cement and sand of the concrete mixture could flow as the concrete was placed, reducing in the stone of the wall the cement binder that was already too small in volume from the proportions of the concrete.

Without the solid rock backing the two-foot wall is not thick enough for the head of water of twenty-four feet. Even with the solid rock backing, eight inches of this concrete is not enough to make watertight work.

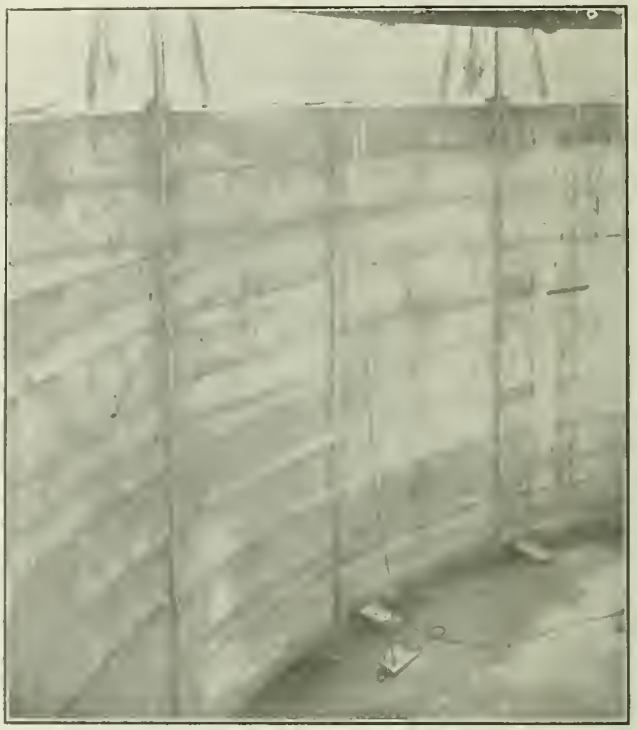
There are no provisions in the specifications for ramming the concrete, for limiting the depth of the layers, nor for jointing old and new concrete.

The following portion of this report is of general interest. It points out the need of careful construction

**The new Concrete Lining partly completed, showing the Method of Working Forms.**

and skilled supervision. After stating that concrete, to be watertight, must not be laid in freezing weather, nor with the thermometer near 32° F., it says:—

"It is to be further noted that no matter how good the material of the concrete, nor how rich the proposed mixture, the excellence of the finished concrete directly depends on the care with which it is mixed and placed, and on continuous, careful, skilled supervision. This fact cannot be too forcibly stated, and should never be omitted from any consideration of concrete construction. There is no form of building where constant personal attention is so absolutely necessary as in concrete work. One barrow of poor concrete or one barrow of good concrete poorly placed in a wall may leave a poor section that cannot thereafter be made dense and tight. When concrete is once cast, no external inspection of the moulded wall can disclose the location or extent of the imperfect work. The builder should be reliable, responsible, and skilled, and the purchaser's inspection should be zealous and unremitting. These pre-requisites are



**The completed Concrete Wall as it appears at the present time.**

quite independent of, and auxiliary to, physical and chemical examinations of the components of the concrete. The general idea is that nearly anybody can make good concrete. The general fact is that the best concrete requires good judgment, good faith, incessant care and attention, and superior skill, as well as first-class materials."

During May of this year tenders were called for the reconstruction of the gas tank holder. The work consisted in rebuilding the interior of the gas tank holder to make it conform to the dimensions called for in the plans prepared by the Davis-Farnum Co., of Waltham, Mass.; of rendering the concrete walls and bottom of the tank impervious, or comparatively impervious, to the action of water; of replacing the gas tank and its framework, fittings, and all other connections in commission. Messrs. Merrill & Allen, engineers, of Toronto and Belleville, respectively, proceeded with the work by first lifting and supporting the two cylinders of the tank. This was a very important step, and by the method employed a perfectly clear space to work in was obtained. The attempts made previously to waterproof by giving the wall a tar paper lining had been accomplished by lifting the outer cylinder only. The accompanying views illustrate the various stages of the work as they progressed and the system employed of lifting and holding tanks in place during the progress of the work.

The original bottom lining was first completely removed and the rock floor prepared to receive the waterproofing lining. The first steps consisted of the removal of the surface of the original concrete walls in order to have a suitable surface for the adhesion of the new lining. The floor was lined with a special four-inch thoroughly waterproofed concrete layer, placed so as to insure thorough adhesion to the rock floor. Sufficient forms were employed to complete two circles at a time, the bottom one being carried above the other at each stage of the work. The walls were then lined with a special three-inch thoroughly waterproofed concrete layer, placed so as to insure thorough adhesion to the original wall. It consisted of a 1:2:4 mixture, with a large percentage of hydrate of lime. Special precautions were taken to insure tightness at the footing of these walls. A thorough drainage system was arranged in order to prevent the possibility of inward water pressure during and subsequent to the operations. The work was completed in less than three months, the guaranteed time. As it stands to-day, it is equal in all essential respects to an entire reconstruction. Tests have been conducted since its completion, and will be continued during the next nine months. The contractors were under a guarantee of a maximum leakage of not over fifteen gallons per hour. They were successful in keeping it under ten gallons, which is much under the guarantee. The contractors, Messrs. Merrill & Allen, have evidently taken every precaution, and have once more demonstrated the fact that concrete well built, with every attention to workmanship and used with discretion, offers no ground for the criticisms of those opposed to the use of this material.

## APPLIED STATICS

(Continued from Page 638.)

From either of the last two Vector Polygons it is seen that both the forces BD and CA act against the pin. This places the members BD and CA, respectively, in compression, the magnitudes of the stresses being found from the magnitudes of the lines BD and CA (Fig. 90).

The stresses in the members DF and CE may be found by constructing the Vector Polygons for the points ACE and BDF, respectively, as shown in Figs. 92 and 94.

(These polygons will be shown next week.)

## COMING MEETINGS.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton, H. Moore, Butte.

**American Association for the Advancement of Science.**—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

**American Society of Agricultural Engineers.**—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

**Association of American Portland Cement Manufacturers.**—December 14-15. Annual meeting at New York City. Secretary, Percy H. Wilson, Land Title Building, Philadelphia,

## ENGINEERING SOCIETIES.

**CANADIAN SOCIETY OF CIVIL ENGINEERS.** 413 Dorchester Street West, Montreal. President, George A. Mountain; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, F. A. James, 62 Church Street, Toronto. Meet last Thursday of the month

MANITOBA BRANCH
Chairman H. N. Ruttan, Secretary, I. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 4241 Flack Block, Vancouver. Meets in Engineering Department, University College

OTTAWA BRANCH—
Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Resident Engineer's Office, Department of Public Works.

**MUNICIPAL ASSOCIATIONS.**

ONTARIO MUNICIPAL ASSOCIATION. President, Mr. George Geddes, Mayor, St. Thomas, Ont; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John I. Hall, Medicine Hat, Alta.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

**CANADIAN TECHNICAL SOCIETIES.**

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

CANADIAN ASSOCIATION OF STATIONERY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Ureo, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth; Secretary-Treasurer, King Radiator Compaoy, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, Francis Dagger, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, C. A. Jefferis; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchel', City Engineer's Office, Edmonton, Alberta.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B Wolsey. Meeting every Thursday eveoing during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

MANITOBA LAND SURVEYORS. President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—Presideot, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA. President, A. F. Dunlop, R.C.A., Montreal, Que.; Hon. Secretary, Alcide Chausse, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 109 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

**AMERICAN TECHNICAL SOCIETIES.**

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders' Bank Buildiog.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS.—President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James, England Canadian Members of Council:—Profs. F. D. Adams, J. B. Porter, and J. B. Tyrrell.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from Page 617)

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8693—November 17—Authorizing the C.P.R. to construct, maintain, and operate a system of industrial spurs for International Elevator Company, and St. Boniface, Man.

8694—November 18—Granting leave to the C.P.R. to open for the carriage of traffic the extension of its Snowflake Branch to Windygates, Manitoba, mileage 0 to 6.5.

8695—November 18—Recommending to the Governor-in-Council for sanction agreement of the C. N. R. with the Northern Extension Railway Company.

8696—November 15—Granting leave to the Winnipeg Electric Railway to operate their cars and trains over crossing at Logan Avenue, Winnipeg, Man., (C.P.R. crossing) for a further period of two months without being brought to a stop.

8697—November 18—Authorizing the C.P.R. to construct, maintain, and operate industrial spurs across Ross Avenue, Xante Street, and over Blocks 89, 90, 91, and 92, Lot 9, Winnipeg, Man.

8698—November 18—Authorizing the corporation of the city of Toronto, Ont., to lay ducts under the tracks of the G.T.R. and C.P.R. near Strachan Avenue, Toronto, Ont.

8699—November 18—Authorizing the city of Toronto to lay ducts under the tracks of the G.T.R. and C.P.R. on Strachan Avenue, (northern crossing), Toronto, Ont.

8700 and 8701—November 18—Granting leave to the village of Brussels, to erect, place, and maintain its wires across the track of the G.T.R. at intersection of its Wellington-Grey-Bruce division, Brussels, Ont., also across the G.T.R. at intersection of its London, Huron & Bruce division with concession line between 4th and 5th concessions, Township of Morris, Ont.

8702 and 8703—November 18—Granting leave to the Horton and McNab Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at a point on Lot 8, Concession 4, Township Horton, Ont., and one mile west of Castleford Station, Ont.

8704 to 8709 Inc.—November 19—Authorizing the C.P.R. to use and operate bridge at mileage 47, on its central division, Prince Albert branch, over the Battle River, western division, Wetaskiwin section; over the Government Drainage Ditch, central division, Lariviere section, and bridges, Nos. 147, 151, 196, 71, 84.3, 99.5, and 132.5 on its Cranbrook section, western division, and bridge 104.17 on its McLeod section over Old Man River, also bridges Nos. 1.5 and 102.9 on the western division, Edmonton section of its railway.

8710—November 19—Granting leave to the C.N.R. to operate temporarily and until further Order of the Board spur constructed by the G.T.P. Railway into the property of the Clover Bar Coal Company at Edmonton, Alta.

8711—October 29—Directing that the C.P.R. provide and construct a suitable highway crossing over its track at a point about one mile west of Carlin Station, B.C.

8712—November 20—Approving and sanctioning location of G.T.P. Railway Company's Calgary branch, mileage 0 to 24.754 Province Alberta.

8713—November 20—Approving and sanctioning location of G.T.P. Railway Company's Tofield-Calgary branch, mileage 24.754 to mileage 50, Alta.

(Continued on page 656)

## PAVEMENTS.

Mr. W. A. Clement, M. Can. Soc. C.E., the city engineer of Vancouver, B.C., and a committee of the Vancouver Council, Aldermen Macmillan and Crowne visited a number of United States cities to study the pavement problem. Several sections of their report are of general interest and the conclusions reached apply to more than one Canadian city.

1. A perfect pavement has not yet been found, no one paving material combining in itself all the desirable qualities.

2. Nearly every paving material possesses at least one advantageous characteristic not possessed by others.

3. Pavements which give good satisfaction in dry climates are often unsuitable for wet climates.

4. Pavements such as stone block, which would be intolerable on residential streets, often become a necessity on heavily travelled business streets.

5. Pavements which have many qualities to recommend them for streets with moderate grades, may be quite unsuitable for steep grades.

6. The increasing use of pneumatic rubber tired passenger vehicles and heavy drays propelled by gasoline and other motive powers makes it necessary that pavements to meet these conditions of travel, should besides having a durable wearing surface, which will provide a sure grip for horses feet, have great strength, and a surface which will, as far as possible, counteract the tendency of auto tires to slip or slide. It is also desirable that the pavements be inexpensive, or at least of moderate cost.

7. Steep grades in the business section.—From observation and information obtained we are of opinion that for streets with a steep grade in the business portion of the city, that sandstone blocks on concrete foundation occupy the first place, but that granitoid, on most of the streets in Vancouver, will serve the purpose equally well at less cost.

8. Moderate grades in the business section.—For streets in the business section with grades not exceeding three per cent. we consider that a pavement constructed of wood blocks of the large size, on concrete foundation, has more desirable qualities for uses in Vancouver, than any other pavement. It has a good surface for traction, is easy on horses and vehicles, is less noisy than other pavements, does not require a costly plant for making repairs, and when worn out, can be resurfaced with other materials. Granitoid would probably cost 10 or 15 per cent. less, and have a durable wearing surface, but would be more noisy, and harder on horses, as all unyielding pavements must be. If the large sized paving bricks of good quality can be obtained at a reasonable cost, they will also make a good durable pavement, but will be somewhat more noisy than granitoid.

9. Residential streets with moderate grades.—For residential streets with grades not exceeding [illegible] cent. would blocks, bitulithic, granitoid and asphalt have more desirable qualities than other paving materials, but we would point out that expensive plants are required for constructing and repairing bitulithic and asphalt pavements, consequently we would not advise their use until the growth of the city warrants the maintenance of a civic plant, nor would we advise their use on streets where there are street railway tracks. In the case of wood blocks and granitoid, the plants required are inexpensive.

10. Residential streets with steep grades.—For residential streets with grades exceeding 5 per cent. we would advise the use of granitoid pavement, as it gives a good foothold for horses, and is not slippery for automobiles.

11. For the paving of lanes with steep grades, we would recommend, as in the case of steep streets, the laying of sandstone blocks, and for moderate grades, granitoid.

# ENGINEER'S LIBRARY

## THE CANADIAN ENGINEER'S MONTHLY INDEX OF CIVIL ENGINEERING LITERATURE.

The purpose of this monthly index is: To inform engineers and contractors of the literature published on those subjects in which they are especially interested, the character of the article and the journal in which it appeared. **We do not index in this section articles that appear in The Canadian Engineer.**

Periodicals containing articles indexed, should be ordered direct from the publishers.

### LIST OF PERIODICALS INDEXED.

**Canadian Society of Civil Engineers Proceedings.**–(Can. Soc. C. E. Proc.), Montreal, Can., m., 4 x 7 in., 50 cents.

**Canadian Cement and Concrete Review.**—(Can. Cem. and Con. Rev.), Toronto, Ont., m., 9 x 14, 15 cents.

**Contractor.**—(Contr.), Chicago, Ill., bi.-w.; 7 x 10 in., 20 cents.

**Engineering—Contracting.**—(Eng.-Cont.) Chicago, Ill., w.; 9 x 12 in., 10 cents.

**Engineering News.**—(Eng. News), New York, N.Y., w.; 10 x 14 in., 15 cents.

**Engineering Magazine.**—(Eng. Mag.), New York, N.Y., 7 x 10 in., 25 cents.

**Good Roads Magazine.**—(Good Rd. Mag.), New York, U.S.A. 9 x 12 in., M., 10 cents.

**Machinery.**—(Mach.), New York, N.Y., m., 7 x 11 in., 20 cents.

**Municipal Journal and Engineer.**—(Mun. Jl. and Eng.), w., New York, N.Y., 9 x 12, 10 cents.

**Municipal Engineering Magazine.**—(Mun. Eng. Mag.), Indianapolis, Ill., m., 7 x 10 in., 25 cents.

**Power and Engineer.**—(Pow. and Eng.), New York, N.Y., w.; 9 x 12 in , 5 cents.

**Railway Age Gazette.**—(R. R. Age Gaz.), New York, w.; 8 x 11 in., 15 cents.

**Surveyor, The.**—(Sur.), London, Eng., w.; 6 x 11, 10 cents.

**Engineering.**—(Engr.), London, Eng., w.; 12 x 15 in., 15 cents.

*Illustrated.

## CONCRETE AND REINFORCED CONCRETE.

**Stresses in Concrete Beams.***—2½ pp. Eng.-Cont., Nov. 10. An article by Professor Gaetano Lanza and Lawrence S. Smith, comparing experimental results obtained from the use of three theories of distributed stresses.

**Concrete Viaduct.***—2½ pp. R. R. Age, Nov. 26; photos and dimension drawings with descriptive article on reinforced concrete viaduct at Rotterdam.

**White Portland Cement.***—Can. Cem. & Con. Review, 4 pp. Facts regarding its manufacture at Clayton, Mass., and its adaptation as a finishing surface to various materials.

## RAILWAYS.

**Valuation of Railway Properties.***—4 pp., R. R. Age, Nov. 19: the author, Robt. Yates, takes up item by item the various departments of the railroad and analyses a system for their valuation.

## SEWAGE AND WATERWORKS.

**Hydraulic Work.*** 2 pp., Power and Eng., Nov 9. W. Burns on plungers, valves, and frames for hydraulic jacks; manner of testing, making and treatment of cup leathers; gutta percha forms.

**Centrifugal Pumps.*** 4½ pp., Power and Eng., Nov. 23, a study of three methods used to find efficiency of centrifugal pumps.

**Water Purification.*** 2½ pp., Mun. Jl. & Eng., Nov. 10; a description of the purification works at Wilmington, Del.

**Storm Water Sewers.*** 2½ pp., Mun. Jl. & Eng., Nov. 10. Methods, formulaes and data used in calculation capacity of storm water sewers in New York

**Pumping Plant and Filters.*** 5 pp., Pow. & Eng., Nov. 16. Describes Torresdale centrifugal pumping station and large filter plant.

## ROADWAYS AND PAVEMENTS

**Roadway Crowns.***—1½ pp., Mun. Jl. & Eng., Nov. 17; a plea for simple statements in place of formulae.

**Mountain Road-building.***—5 pp., Good Road Mag. Describes construction of road to and up Mount Rainier.

## LIGHT, HEAT, AND POWER

**Steam Boilers.***—3 pp., Pow. & Eng., Nov. 16. Telling what should be done to render safe and keep in good condition small boilers.

## MISCELLANEOUS.

**Cost of Erecting Steel Smoke-stack.***—½ p. Eng.-Cont., Nov. 10. Method and cost of erecting a sixty-six inch by a hundred and sixty foot steel stack in one piece.

**Stadia Rod.***—½ p., Eng.-Cont., Nov. 17; design and method of constructing a stadia rod, divided to tenths.

**Manhattan Bridge.***—9 pp., Eng.-News, Oct. 14; a copy of Ralph Modjeska's report on the design and construction of the Manhattan Bridge over East River, New York.

**Bridge Construction.***—2½ p.p., Cont., Nov. 15; dealing with method of bridge construction and erection.

**Broadway Street Bridge.***—7 pp., Eng. News, Nov. 25; describing the desgin and giving particulars of erection and test of this bridge.

## BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

**Pocket Companion,** containing useful information regarding the use of iron and steel, for engineers, architects, and builders; leather bound, gilt edges, 300 pages pocket size. Carnegie Steel Company, Pittsburgh, Pa.; Mr. T. Guilford Smith, manager of sales, 208 Ellicott Square, Buffalo, N.Y., U.S.A., together with a seventy-page supplement, Part I., of which contains corrections and additions to the data published in the above company's well-known shape book of 1903. Part II. of the supplement includes many new sections and several tables of weights not given in the larger publication, which contains a host of information on angles, beams, channels and steel work generally, as well as tables of properties and new tables of safe loads for channel columns.

**Standard Steel Construction,** 1908, revised by Mr. F. L. Garlinghouse, C.E., member A.S.C.E., and published by the

Jones and Laughlin Steel Company, of Pittsburg and Chicago. U.S.A. Pocket size, 300 pages, leather bound.

This revised edition of the above company's standard handbook contains data relating to beams, channels, and structural shapes. The permissible working shear and bearing for rivets has been brought up-to-date to make it consistent with the balance of unit loads used in proportioning steel structures. The standard specifications for structural steel are given in full and correspond with those adopted in 1903 by the Association of American Steel Manufacturers. Much old matter has been revised, while new material of value has also been added.

**"Electric Lamps."**—By Maurice Solomon, A.C.G.L., A.M.I.E.E. Published by Archibald Constable & Company, London. 321 pp., 112 illustrations, and 34 tables. Price, net, $1.80. The book, as its name implies, is a treatise describing the manufacture, operation, testing and characteristic of electric lamps which have been proved a commercial success. The opening chapters briefly discuss artificial illumination, studying the characteristics that distinguish it from daylight, defining the various technical terms in common use and their importance in the science of illumination. The various photometers in use are described and the principles of their operation clearly given, with a discussion on the common methods of testing electric lamps. The practical manufacture of the carbon filament, Nernst and metallic filament lamps, is described in detail, taking up life tests, distribution of light and efficiency, accompanied by numerous general curves of distribution and efficiency. Arc lamps are discussed generally, touching on their characteristics, operation, efficiency, and the manufacture of carbons. The newer types of flame arc lamps being given considerable attention. The author concludes by comparing the various types of lamps as light producers and their use, giving tables showing the relative efficiency, including cost of power, maintenance and renewals. The book is well written by one familiar with the practical manufacture of lamps and contains much useful information.—F. A. G.

**Railroad Curves and Earthwork.**—By C. Frank Allen, S.B. Published by Spon & Chamberlin, 123 Liberty Street, New York. Leather binding, 4½ x 6½; pages, 225; price, $2.00.

This is the fourth edition, and in revising this work the chapter on Turnouts has been rewritten so as to apply to split switches.

The book contains chapters on: 1. Reconnoissance. 2. Preliminary survey. 3. Location survey. 4. Simple curves. 5. Compound curves. 6. Reversed curves. 7. Parabolic curves. 8. Turnouts. 9. "Y" tracks and crossings. 10. Cubic spiral easement curve. 11. Setting stakes for earthwork. 12. Methods of computing earthwork. 13. Special problems in earthwork. 14. Earthwork tables. 15. Earthwork diagrams. 16. Haul. 17. Mass diagram. Tables and diagrams. Diagram for three level sections Base 14, slope 1½ to 1. Diagram for three level sections Base 20, slope 1½ to 1. Diagram for prismoidal correction, diagram for triangular prisms. It is a compact convenient work, handy to carry, complete and very useful on railroad location, construction or maintenance.

**Field and Office Tables.**—By C. Frank Allen, S.B. Published by Spon and Chamberlin, 123 Liberty Street, New York. Limp leather binding, 4½ x 6½; pages, 293; price, $3.00.

This is a companion book for Railroad Curves and Earthwork by the same author. The two books may be secured in one binding for $3.00.

It is hoped that these tables will be found more complete than those that have preceded. Great care has been taken by the author in the selection, arrangement and computation of these tables. The tables having been checked by several expert mathematicians to correct them from any errors. The tables given are:—Radii and their Logarithms, Tangent Offsets and Middle Ordinates, Tangent Distances for 1° Curve, Corrections for Tangent Distances, External Distances for a 1° Curve, Offsets from Tangent for a 10° Curve, Angles Proportional to Squares of Distances, Long Chords and Actual Arcs, Acres for Strip 100 Feet Wide, Curves for Metric System, Barometric Heights, Logarithms of Numbers, Logarithmic Sines, Cosines, Tangents and Cotangents, Auxiliary Tables for Logarithmic Sines and Tagents of Small Angles, Logarithmic Versed Sines and External Secants, Auxiliary Versed Sines and External Secants of Small Angles, Natural Sines and Cosines, Natural Tangents and Cotangents, Natural Versed Sines and External Secants, Lengths of Circular Arcs; Radius = 1, Squares, Cubes, Square Roots, Cube Roots and Reciprocals, Turnouts and Switches, Velocity Heights, Rise per Mile of Various Grades, Elevation of Outer Rail on Curves, Inches in Decimals of a Foot, Middle Ordinates for Curving Rails, Stadia Reductions, Horizontal and Vertical, Mean Refractions in Declination, Triangular Prisms; Cubic Yards per 50 Feet, Prismoidal Correction; Cubic Yards per 100 Feet, Three Level Sections; Cubic Yards for 50 Feet, Cubic Spiral Easement Curves, Numbers and Formulas, Explanation of Tables.

**Specifications.**—Compiled by the Canadian Inspection Company, Stair Building, Toronto, Ont., and Canadian Express Building, Montreal. Size, 4½ x 6; pages, 130.

This publication contains specifications for bridges, steel and malleable castings, steel rails, splice bars, track spikes, track bolts, galvanized iron wire, woven wire fence, cast iron pipe, and cement.

It also contains several pages of useful tables dealing with weight, specific gravity of materials, etc.

**Co-Ordinate Geometry as Applied to Land-Surveying.**—By Woodford Pilkington, M. Inst. C.E. Published by Spon and Chamberlain, 123 Liberty Street, New York. Size, 4 x 6; pages, 46; price, 40 cents.

The author describes a method of making surveys and preparing diagrams to be used in the description and transfer of land where property is located by triangulation surveys. It would be a system admirably suited for Nova Scotia and New Brunswick where the records and systems of survey are so ill-defined and complicated.

**Essentials of Sanitary Science.**—By Gilbert E. Brooke. Published by Henry Kimpton, Holborn, London, E.C.

The edition is prepared specially for the student in sanitary science, and should prove of great value to medical men who desire to take up public health.

The sanitary engineer is at times faced with chemical questions arising out of his work, he will find the above concise edition extremely handy as a work of reference in throwing light upon questions affecting purity of water or sewage effluents. It is more a text-book than a treatise and deals extensively with definitions relating to questions in hydrostatics, pneumatics, heat, meterology, air, water, disinfectants, bacteriology, vital statistics, sanitary administration, etc., etc. We are sometimes asked by the sanitary engineer to recommend a book which will explain many of the terms used by chemists and bacteriologists in dealing with water and sewage questions. We can recommend the above small volume as just giving the necessary information required.—T. A. M.

**"Sanitary Engineering."**—By Colonel E. C. S. Moore, R.E. Third edition, two volumes, revised, and in part re-written, by E. I. Silcock, M. Inst., C.E. Published by B. T. Batsford, High Holborn, London, in two volumes. Pages, 950; tables, 160; illustrations, 920; price, $12.00.

This edition recently published forms a complete up-to-date book of reference on sanitary engineering, and will at once take its place as a leading treatise on the subject. In fact since the now out of date publications by Baldwin, Latham & Baily Denton, no such complete and extensive work has been placed on the market. Vol. 1 deals with Sewerage, Hydraulics, Sewer and Drain Ventilation, Sanitary Fittings and Apparatus; while Vol. 2 includes Land Drainage, Sanitary Notes, Sewage Disposal, Refuse Destructors, Trade Effluents, and Sewage Fungus.

In preparing the present edition Mr. Silcock has kept as far as possible to the general arrangement adopted by the late Col. Moore, but the work is brought entirely up-to-date, and much new and valuable information added dealing with the recognized methods of **Sewage Purification and Sewage Ventilation.** The large number of complete plates including plans and details of modern works will be found most useful, both to the student and practising engineer. A résumé of the reports of the Royal Commission on Sewage Disposal form part of the work. New and valuable information is introduced upon questions of:—"Rainfall in Sewers," "Sewage Lifting," "Trade Effluents," "Sewage Fungus," etc.

The standard value of Moore's hydraulic tables have universal recognition, and the practical and useful manner in which they are presented for easy reference will appeal to every sanitary engineer.

On going through the two volumes, it appears impossible to point to any one subject in connection with sanitary engineering which is not fully dealt with. Even questions in detail on plumbing are just as carefully gone into in detail as more important engineering subjects.

We must certainly advise every engineer on public health questions to see to it that he has these two valuable volumes within reach for immediate reference.—T. A. M.

**Modern Methods of Street Cleaning.**—By Geo. A. Soper, Ph.D., M.A.S.C.E. Published by the Engineering News Publishing Company, New York. Price, $3.

This edition is largely the result of a three months' visit to Europe in 1907 by the author, in order to collect notes for an advisory commission on street cleaning for New York, appointed by Mayor McClellan. Much valuable statistical information is given in connection with several large European cities, including London, Paris and Berlin. A comparison is made between foreign methods of street cleaning and those in vogue in New York City.

Valuable information is supplied generally upon such questions as "Reason for extravagance and inefficiency in street cleaning." "Preventable and Unavoidable Littering," "Public Receptacles for Refuse," "General Methods of Street Sweeping," and the "Use of Water in Cleansing Pavements," etc. The volume is of great practical interest and should prove of considerable value to those in authority over street cleaning departments.—T. A. M.

**Investigation of the Peat Bogs and Peat Industry of Canada,** by Erik Nystrom, M.E., and S. A. Aurep, M.E. Bulletin No. 1 Department of Mines, Ottawa. Pages 25. Size, 6 × 9.

The importance of the peat fuel industry to the central portion of Canada, where coal fuel is non-existent and its importation so comparatively costly, requires no demonstration.

The mines branch of the Department of Mines, Ottawa, issued a year ago a report on "Peat and Lignite, their Manufacture and Uses in Europe," with the object of giving to Canadians as complete a review as possible of this industry in those countries in which it has been most successfully carried on.

This report is now followed by a bulletin entitled "The Investigation of the Peat Bogs and Peat Industry of Canada during the season of 1908-09," by Erik Nystrom, M.E., peat expert. This bulletin comprises 25 pages of text, and includes six large scale maps of the following peat bogs:—

1. Mer Bleue, near Ottawa.
2. The Alfred Peat Bog, about 40 miles from Ottawa.
3. The Welland Peat Bog, about six miles north of Welland.
4. The Newington Bog, on the New York and Ottawa Railway, and about 40 miles from Ottawa.
5. The Perth Bog, a mile and a half from Perth.
6. The Victoria Road Bog, about a mile from Victoria Road Station on the Midland division of the Grand Trunk Railway.

The bulletin contains a descriptive report of each bog, showing the location, area, and structure, and giving an estimate of the available supply of peat fuel with records of analyses, calorific value, etc., and should be of particular interest to those engaged in or connected with, the development of Canadian peat resources.

A fuel testing plant is now being erected at Ottawa, in which the value of peat for the production of power gas will be demonstrated, and the Department proposes to carry on a very thorough investigation of this subject.

Copies of the above Bulletin and Report on Peat may be had on application to Dr. Haanel, Director of Mines, Ottawa.

**A Brief History of Cements.**—An interesting booklet written by I. C. Johnson, of Mayfield, Gravesend, England, and published by the Cement Record Company, Kansas City, Mo. The original invention and early history of Portland cement is not in general thoroughly understood. As the preface states, text books on cement and concrete mention those men who have gained fame through inventions that have aided the industry to develop to its present stage, but the early history and those who were first to understand this material and the difficulties, etc., under which they labored has been but little touched upon. This book contains a biography of Mr. Johnson, a brief history of cements, as well as other information as to the early days of its manufacture that will be read with interest. It is well illustrated. The price is fifty cents.

**Railroad Promotion and Capitalization in the United States,** by Frederick A. Cleveland, Ph. D., and Fred Wilbur Powell, A. M. Longmans, Green, & Company, publishers, 91 and 93 Fifth Avenue, New York, U. S. A.

Over three hundred pages of valuable information, gathered from many sources, carefully classified and indexed, constitute a volume whose scope is practically unlimited. Each of the eighteen chapters teems with data affecting the administration and affairs of railroads that is available in no other single publication.

Notes regarding the conditions existing in the 18th sentury—the first era of transportation development—are given in the opening chapters. Early accounts of the railway, views expressed in 1802 as to the practicability and the advantages of a general system of railroads, and much early history of the locomotive, including references to the men responsible for the first steam engines built, together with a few pages devoted to the situation in America at that time, comprise Chapter III. Observations apropos of the effect of

early experiments on popular and investment opinion, backed up by an abundance of conclusive testimony, brief mention of the question of signals and double-tracking, and reference to the elements of opposition and the results of practical demonstration, with some notes relative to the lines constructed during the forties, form the fourth chapter.

Chapter V., entitled "The Economic Basis of Transportation Development," is devoted to a discussion of transportation enterprise from the point of view of investors and capitalists. Railway transportation and canal transportation are compared—to show the advantages possessed by railway. State finding of transportation enterprise, rivalry between trade centres in its relation to promotion and capitalization and the promotion of private companies are the subjects dealt with in the sixth, seventh and eighth chapters, while chapter IX. is devoted to Reconnaissance and Surveys.

Promoters will be particularly interested in chapter X., which takes up legislative provisions as an element in promotion and capitalization. This embraces, among others, the questions of charter and general laws, right to operate, maximum rates for operation, limit of profits, monopoly privileges, tax exemptions and subsidy laws. Chapters XI. and XII. deal with the methods of appeal for financial support and individual and local subsidies to private companies, while thirty pages immediately following are devoted to State aid to private companies, the reaction against State and local subsidies and National aid to private companies. Chapter XII. on Transcontinental Railroads is especially interesting. It is followed by a section which relates to financial institutions and syndicates as agencies of capitalization, and the volume concludes with a good bibliography and an alphabetically-arranged list of sources and materials which is of inestimable value.

Much has been written upon the subject of railway promotion and kindred subjects, but for many reasons which it is unnecessary to enumerate, "Railroad Promotion and Capitalization" must take first place.—Wm. M.

**Report on Chromite Deposits.**—The Mines Branch of the Department of Mines of Canada has just issued a "Report on the Chrome Iron Ore Deposits of the Eastern Townships," by Fritz Cirkel, M.E.

In the last few years, owing to the rapid development of the iron and steel industry in Canada, more than ordinary interest has been manifested by the mining and metallurgical public in respect to the Canadian deposits of raw materials and ores, which enter into the manufacture of iron and steel products. To meet the demand for information on these subjects, the Mines Branch has undertaken to issue a series of reports on the Canadian deposits of the substances which form the basis of the iron and steel industry. Several reports on iron ores and one on tungsten ores have already been issued and the present report is another of this series.

The scope of the "Report on the Chrome Iron Ore Deposits in the Eastern Townships of the Province of Quebec" is best judged by quoting the Table of Contents, which is as follows:

"Introduction.—Chapter I., Historical; Chapter II., The Chrome Iron Ore Deposits of Canada; Chapter III., Mining of Chrome Iron Ore; Chapter IV., Dressing for the Market; Chapter V., Market Prices, and Status of the Canadian Industry; Chapter VI., Chrome Iron Ore Mines: Prospects in Canada; Chapter VII., Chrome Iron Ores in Foreign Countries; Chapter VIII., Origin; Chapter IX., Composition of Chrome Iron Ores; Chapter X., Statistics and Chronology; Chapter XI., Determination of the Value of Chromium; Chapter XII., Uses of Chromium; Chapter XIII., Technology of Chromium and its Compounds; Appendix II., Experiments with Chromite at McGill University; Bibliography."

The report is well illustrated by eleven plates in halftone, from photographs of mines, mills and machinery; and fifteen diagrams, maps and drawings all illustrative of the chromite industry. The author of the report is Mr. Fritz Cirkel, Mining Engineer. This work was entrusted to Mr. Cirkel on account of his long connection, as consulting engineer, with the chromite and the asbestos industries; the deposits of these two substances in the Province of Quebec occur in the same region, and the origin of both is closely connected with the serpentine rocks of the Eastern Townships.

The typography of the report is very good and the book will form a welcome addition to the library of the mining engineer, the metallurgist, and the capitalist interested in the iron and steel industry. Moreover, it may be pointed out that the chapters on the uses, the technology, the metallurgy of chromium, and those on the origin, the composition of chrome iron ores, as well as the Bibliography, will be appreciated by all students and investigators on the subject of Chromium and Chromite.

The book is obtainable on application to Dr. Eugene Haanel, Director of Mines, Department of Mines of Canada, Ottawa.

The several occurrences of tungsten ore in Canada are described in detail, and a general statement is given on the geological occurrence of the ores, chemical tests, concentration, the uses of the metal, producing mines in other countries, statistics of the world's production, etc., while a very useful bibliography of the literature on Canadian and United States occurrences is added.

In view of the present condition of the iron ore industry of Canada and particularly Nova Scotia, where so much imported iron ore is being used, this report should be of special value to mining engineers, investors and others interested in the development of the iron resources of this province.

## PUBLICATIONS RECEIVED.

**Methods and Devices for Bacterial Treatment of Sewage.**—By William Mayo Venable, M.S., M. Am. Soc. C.E. First edition, 240 pages, 6 x 9, $3. Published by John Wiley & Sons, New York, U.S.A.; Renouf Publishing Company, Montreal.

**Publications:**—New Catalogue of the Publications of the Geological Survey, Department of Mines, Ottawa, (No. 1073) —revised to July 1, 1909. Issued September, 1909.

**White Horse Copper Belt**—Report on the Whitehorse Copper Belt, Yukon, by R. G. McConnell, (No. 1050). Published October, 1909, by the Geological Survey, Department of Mines, Ottawa. Pp. 63, 4 illustrations, 8 maps.

**Rossland Camp.**—Geological Map of Rossland Mining Camp B.C., scale of 1,200 feet to 1 inch. Published by the Geological Survey, Department of Mines, Ottawa, 1909.

**Coal Fields.**—Report on the Coal Fields of Manitoba, Saskatchewan, Alberta and Eastern British Columbia, by D. B Dowling, (No. 1035) Published, October, 1909, by the Geological Survey, Department of Mines, Ottawa. Pp. 111, 1, illustrations, and colored map.

**CONSULT OUR CATALOGUE INDEX** on page 6. We can put you into immediate touch with the principal manufacturers of and dealers in all kinds of engineering and contracting equipment. A postcard to this department will insure the receipt of the desired catalogue.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Nov. 28 1909 | 1908 | STOCK QUOTATIONS TORONTO Price Dec. 3 '08 | Price Nov. 25 '09 | Price Dec. 2 '09 | Sales Week End'd Dec. 2 | MONTREAL Price Dec. 3 08 | Price Nov. 25 09 | Price Dec. 2 '09 | Sale Week End' Dec. 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,682,000 | 2,141,000 | 176 | 177¾ | 176¾ | 1781 | 601 | 176¾ | 175¾ | 177 | 176¾ | 178¼ | 178½ | 610 |
| Canadian Northern Railway | 3,180 | ..... | ..... | 441,500 | 377,900 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 2,127,837 | 1,007,266 | ..... | ..... | ..... | 1st. pref. 103½, 3rd pref. 50½, ordinary 20½ | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | 48,420 | 25,739 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 74,838 | 68,575 | ..... | ..... | ..... | ..... | ..... | 203½ | 203 | 213¾ | 213¼ | 212½ | 211 | 682 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,625 | 67,836 | 108 | 107 | 124½ | 124½ | 125 | 124¼ | 10 | 107½ | 107 | 124¼ | 124½ | 121 | 716 |
| Winnipeg Electric | 70 | 6,000 | 100 | ..... | ..... | 167½ | 167 | 185 | 185 | ..... | 170 | 166 | ... | ..... | ..... | ..... | ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## RAILWAY ACCIDENTS IN CANADA.

A statement showing the character of accidents on various railways operating in Canada under Dominion charter for year ending March 31st, 1909, as compiled by the Board of Railway Commissioners for Canada.

| Character of Accident. | Passengers. K. | Passengers. I. | Employees. K. | Employees. I. | Other Persons. K. | Other Persons. I. | Totals. K. | Totals. I. |
|---|---|---|---|---|---|---|---|---|
| Derailment | 1 | 87 | 10 | 40 | .. | 4 | 11 | 131 |
| Head-on collision | 3 | 23 | 25 | 39 | .. | 2 | 28 | 64 |
| Steating ride | . | .. | .. | .. | 2 | 12 | 2 | 12 |
| While shunting | . | .. | 1 | 6 | .. | .. | 1 | 6 |
| Level crossing | . | .. | .. | .. | 41 | 54 | 41 | 54 |
| Falling off freight cars | . | .. | 12 | 36 | 3 | 2 | 15 | 38 |
| Trespassing | . | .. | .. | .. | 83 | 57 | 83 | 57 |
| Body found on track or bridge | 1 | .. | 1 | .. | 47 | .. | 49 | .. |
| While switching | 1 | .. | 15 | 39 | 2 | 1 | 18 | 40 |
| Pitch-in with hand car | . | .. | 6 | 6 | 2 | .. | 8 | 6 |
| Died on train, natural cause | 1 | .. | .. | .. | .. | .. | 1 | .. |
| Working under cars | . | .. | .. | 4 | .. | .. | .. | 4 |
| Struck looking out of cab window. | . | .. | .. | 5 | .. | .. | .. | 5 |
| Suicide | 1 | .. | 1 | .. | 5 | .. | 7 | .. |
| Struck by switch stand | . | .. | 1 | 8 | .. | .. | 1 | 8 |
| Adjusting couplers coupling | . | .. | 11 | 60 | .. | .. | 11 | 60 |
| Passengers falling off trains | 7 | 10 | .. | .. | .. | .. | 7 | 10 |
| Working on track | . | .. | 22 | 23 | .. | .. | 22 | 23 |
| Working on bridge | . | .. | 2 | 2 | .. | .. | 2 | 2 |
| Collision rear end | 7 | 50 | 8 | 14 | .. | .. | 15 | 64 |
| Collision street car and steam car | . | .. | 1 | 1 | .. | .. | 1 | 1 |
| Boarding train in motion | 1 | 9 | 3 | 17 | 8 | 12 | 12 | 38 |
| Side ladders | . | .. | .. | 7 | .. | .. | .. | 7 |
| Falling off cars | . | .. | 1 | 3 | 1 | .. | 2 | 3 |
| Fell off work train | . | .. | .. | 2 | .. | .. | .. | 2 |
| Falling off hand car | . | .. | 1 | 8 | .. | .. | 1 | 8 |
| Farm crossing | . | .. | .. | .. | 1 | .. | 1 | .. |
| Bridge burnt | . | .. | .. | 3 | .. | .. | .. | 3 |
| Collision with cars standing foul. | . | 2 | .. | 6 | .. | .. | .. | 8 |
| Under construction | . | .. | .. | .. | 9 | 18 | 9 | 18 |
| Working under engine | . | .. | 1 | 2 | .. | .. | 1 | 2 |
| Locomotive explosion | . | .. | 2 | .. | .. | .. | 2 | .. |
| Jumping off train in motion | 3 | 15 | 4 | 17 | 2 | 4 | 9 | 36 |
| Wash out | . | 4 | 4 | 2 | .. | .. | 4 | 6 |
| Riding on pilot of engine | . | .. | .. | 6 | .. | .. | .. | 6 |
| Working on the cars and engines | . | .. | .. | 2 | .. | .. | .. | 2 |
| Overhead bridge | . | .. | .. | 2 | .. | .. | .. | 2 |
| Fell off tender when moving water spout | . | .. | .. | 7 | .. | .. | .. | 7 |
| Working in shop | . | .. | 2 | 97 | .. | .. | 2 | 97 |
| Falling off bridge or trestle | . | .. | 6 | 6 | 4 | 4 | 10 | 10 |
| Struck by water spout | . | .. | .. | 2 | .. | .. | .. | 2 |
| Ran into open switch | | 10 | 5 | 14 | .. | .. | 5 | 24 |
| Unclassified | . | 17 | 46 | 283 | 21 | 35 | 67 | 335 |
| Totals | 26 | 227 | 191 | 769 | 231 | 205 | 448 | 1,201 |

Comparing the number of killed and injured this year with last we find:—

| | Passengers. K. | Passengers. I. | Employees. K. | Employees. I. | Other Persons. K. | Other Persons. I. | Totals. K. | Totals. I. |
|---|---|---|---|---|---|---|---|---|
| Year ending March 31st, 1908 | 64 | 326 | 246 | 806 | 219 | 177 | 529 | 1,309 |
| Year ending March 31st, 1909 | 26 | 227 | 191 | 769 | 231 | 205 | 448 | 1,201 |
| Increase over 1908 | .. | ... | ... | ... | 12 | 28 | ... | ..... |
| Decrease over 1909 | 38 | 99 | 55 | 37 | ... | ... | 81 | 108 |

Toronto Street Railway earnings for week ended December 4th, were:—1909, $75,710; 1908, $68,302; increase over 1908, $7,347. The gross earnings of the Halifax Electric Tramway for the final week in November amounted to $4,668.80, an increase of $978.21.

C. P. R. traffic returns for October, 1909: Gross earnings, $9,744,597; working expenses, $5,358,300; net profits, $4,386,297. In October, 1908, the net profits were $2,655,267 and for four months ended October 31st, 1909, the figures are as follows: Gross earnings, $32,634,789; working expenses, $19,372,674; net profits, $13,262,115. For four months ended October 31st, 1908, there was a net profit of $9,623,346. The increase in net profits over the same period last year is therefore for October $1,731,030 and for four months ended October 31st, there was an increase of $3,638,769.

Industrial accidents occurring to 439 individual workpeople in Canada during the month of October were reported to the Department of Labor. Of these 146 were fatal, and 293 resulted in serious injuries. Twenty-six railway employees were killed and 44 injured. During the month there were eleven trade disputes in existence, affecting 68 firms and 4,361 employees. The loss of time to employees was approximately 100,190 working days, compared with 37,880 days in October of last year.

## NOVEMBER RAILWAY EARNINGS.

### Steam and Electric Roads in Canada.

Although a decrease is shown when the figures for the past two months are compared, the railway earnings for November, 1909, indicate an increase of two million dollars over the same month in 1908, so far as the companies included in the accompanying table are concerned, while the returns for the eleven months of this year show an increase of over sixteen millions as compared with the same period last year.

Here is a statement showing how the figures for the past three months compare:—

| | November, '09. | October, '09. | Sept., '09. |
|---|---|---|---|
| C. P. R. | $8,868,000 | $9,684,000 | $8,148,000 |
| C. N. R. | 449,500 | 1,384,200 | 1,076,000 |
| G. T. R. | 1,127,837 | 4,043,361 | 3,959,004 |
| T. & N. O. | 155,347 | 161,366 | 153,217 |
| Montreal St. | 330,693 | 305,652 | 307,489 |
| Toronto St. | 325,016 | 332,453 | 379,581 |
| London St. | 18,693 | 19,047 | 24,645 |
| | $11,275,086 | $15,930,079 | $14,047,936 |

| Road | Nov., '09. | Nov., '08. | Increase. | Jan'y 1st to Nov. 30, '09. | Jan'y 1st to Nov. 30, '08. | Increase |
|---|---|---|---|---|---|---|
| Canadian Pacific | $8,868,000 | $7,106,000 | $1,762,000 | $75,824,860 | $63,236,000 | $12,588,860 |
| Canadian Northern | 449,500 | 377,900 | 71,600 | 8,604,160 | 7,650,700 | 953,460 |
| Grand Trunk | 1,127,837 | 1,007,266 | 120,571 | 34,651,278 | 32,057,220 | 1,694,058 |
| T. & N. O. | 155,347 | 77,813 | 77,534 | 1,390,569 | 767,055 | 632,514 |
| Montreal Street | 330,693 | 294,764 | 35,929 | 3,278,272 | 3,071,377 | 206,895 |
| Toronto Street | 325,016 | 286,557 | 38,459 | 3,241,233 | 2,938,636 | 302,597 |
| London Street | 18,693 | 17,290 | 1,403 | 216,849 | 210,667 | 6,182 |
| Totals | $11,275,086 | $9,167,590 | $2,107,496 | $127,216,221 | $110,831,655 | $16,385,566 |

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Nova Scotia.**

FREDERICTON.—Tenders for lighting will be received up to noon on December 13th, for installing acetylene lighting plant in the Provincial Education Office. John Morrissy, Chief Commissioner of Public Works.

**Quebec.**

MONTREAL.—Tenders will be received until Saturday, the 11th December, for tile floor, city hall building. L. O. David, City Clerk.

QUEBEC.—Contractors for bridge superstructure are invited to visit the office of the Board of Engineers in the Canadian Express Building, Montreal, after January 3rd, 1910, where information may be had to enable them to prepare bids for the superstructure of a 1,758 feet span bridge 88 feet in width. The contractor is invited to submit alternative designs, which must conform to the conditions laid down in the general specification. L. K. Jones, secretary, Department of Railways and Canals, Ottawa. (Advertised in the Canadian Engineer.)

**Ontario.**

BERLIN.—Tenders will be received up to 14th December by Edmond Pequegnat, secretary of the Berlin School Board, Berlin, Ont., for the erection of an eight-rooom public school. Munro & Mead, architects, Hamilton, Ont.

KINGSTON.—Tenders will shortly be invited by the city engineer for next year's supply of cement and tile. Mr. H. B. R. Craig is the city engineer.

KINGSTON.—Tenders for ordnance store fittings will be received until Monday, December 13. Mr. Napoleon Tessier, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received upto three o'clock Tuesday, December 14th, for the construction of a tile pipe sewer on St. Patrick Street, between King Edward Avenue, and Notre Dame Street. Newton J. Ker, City Engineer.

ST. THOMAS.—Tenders will be advertised for by the city in a few days for motors and transformers for the power house, to be installed in connection with the Hydro-Electric power.

TORONTO.—Tenders will be received until Monday, December 20th, for alterations and fittings, Drill Hall, Toronto. Further particulars obtainable on application to Mr. Thos. Hastings, Clerk of Works, Toronto; Napoleon Tessier, secretary, Department of Public Works, Ottawa. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until December 13th, for labor, tools, machinery and plant for grading between Cobalt and North Cobalt. Mr. A. J. McGee, secretary-treasurer, T. & N. O. Railway, 25 Toronto Street, Toronto.

TORONTO.—Tenders will be received until December 21st for a supply of 48-inch special castings for the connection between the waterworks tunnel and the new 15 million gallon engine. Mr. Joseph Oliver, (Mayor) Chairman Board of Control; Mr. C. H. Rust, City Engineer. (Advertisement in the Canadian Engineer.)

**Manitoba.**

WINNIPEG.—Tenders for poles will be received until December 10th, for the supply of Telegraph Poles, required for 1910. F. C. Paterson, Chairman Telephone Commission.

WINNIPEG.—Tenders will be received up to Friday, December 31st, for the supply of about eighteen thousand posts, for the manufacture and delivery of about forty-two miles of woven wire fence, and for the erection of the fence along the right-of-way of the City's Transmission Line, between the Brokenhead River and the city. M. Peterson, Secretary, Board of Control.

**Alberta**

WETASKIWIN.—Tenders are invited for a steam pump. Write Alderman Gross, Fire, Light and Water Committee.

**British Columbia.**

NELSON. — By the Nelson Street Railway Company, Limited, tenders are requested for two semi-convertible cars and for station metering and switching equipment, full particulars of which with copies of specifications can be secured at the office of E. B. McDermid, Secretary-treasurer.

**U. S. A.**

ALBANY, N. Y.—Tenders will be received until Tuesday, December 28th, for improvements to the Erie and Champlain canals. Further particulars on application to F. C. Stevens, superintendent of Public Works, Albany, N. Y., and at Canal office, Spaulding's Exchange, Buffalo, N. Y.

DETROIT, MICH.—Proposals will be received up to Tuesday, December 28th, for furnishing and erecting the structural steel and iron work for Engine Room building of the New Pumping Station. Benj. F. Guiney, Secretary.

## CONTRACTS AWARDED.

**Nova Scotia.**

FREDERICTON.—The contract for rebuilding the Gaudet bridge at Shediac has been given to Julien Cormier, of Shediac, at about $3,000.

**New Brunswick.**

ST. JOHN.—At a recent council meeting tenders for a new boiler were opened. The St. John Iron Works tender was $569; the Phoenix Foundry wanted $685, and the International Power Company, Boston, $975. The tender of the iron works was accepted. Frank E. Jones's tender of $170.80 for wiring City Hall was accepted.

**Quebec.**

HULL.—On Monday the council opened tenders in connection with the bridge over Brewery Creek. The bids were as follows: Mr. Brisson, $4,658; Carriere & Wilson, $6,032; Mr. Laverdure, $5,263. The contract was awarded to Mr. Brisson and the ironwark to the Trussed Concrete Steel Company, of Toronto, at a figure of $1,115. The pump tenders left over until next Monday.

QUEBEC.—It is undertsood that the contract for the sub-structure of the new Quebec bridge has been awarded to Mr. M. P. Davis, the Ottawa contractor who built the original pier work. The price of the new work is stated as in the neighborhood of $2,500,000.

**Ontario.**

COLLINGWOOD.—J. Stephens was given a contract at $775, for seating in exhibition building which will be used as a rink.

HAMILTON.—The Canadian Westinghouse Company will probably install the motors for the waterworks pumps at the beach for Hydro-Electric power.

HAMILTON.—Contracts were awarded as follows at a recent meeting of the council:—1,400 foot sewer on Barton Street, Andrew Mercer, $112 per foot; other tenders, S. Cheeseman, $124; city engineer $110. New septic tank at Ferguson Avenue disposal works, Sawyer-Massey Company, $438; only tender received; pile driving, E. A. Fearnside, 35 cents a foot; only tender received.

NORTH TORONTO.—A contract for the installation of a fire alarm system at North Toronto, has been awarded to the Holmes Electric Company of Toronto, at $1,400.

TORONTO.—At Wednesday council meeting the Gaul Lumber Company and the J. B. Reid Company, got all the lumber contracts for an exceptionally large quantity and the Canada Foundry Company the contract for supplying 2,000 lengths of 12-inch cast-iron pipe at $16.75 a length.

PORT COLBORNE.—Messrs. H. W. Petrie, Limited, of Toronto and Montreal, have been awarded the contract by this municipality for a single-acting, triple power pump with a capacity of 400 gallons per minute against a pressure

of 80 lbs., erected on foundation, ready for operation, at $1,950.

**Saskatchewan.**

SASKATOON.—A contract for the construction of an attachment to the C. N. R. bridge was awarded to Strickland Brothers at $2,200.

**Alberta.**

WETASKIWIN.—Contracts have been awarded by this municipality for a 40 h.p. gas engine to the Canadian Westinghouse Company, at $3,200, and for a Dean gas driver pump, at $1,950.

**British Columbia.**

SOUTH VANCOUVER.—This municipality has let a contract for grading south boundary of 667, at $26 per chain to S. Bliss. The road is to be cleared 33 feet wide and 24 feet graded between outside and ditches. Mr. Bliss also received a contract for clearing and grading Somerville Street, at $22 a chain, while Joseph Rogers was given an order for grading and clearing at $22.50 per chain.

VICTORIA.—Contracts for twelve steel tubular poles for trolley and arc lamp supports have been awarded by this city to Messrs. Hutchinson Bros., Company, Limited, of Victoria, at $1,500.

VICTORIA.—Tenders for thirty-five tons of lead pipe were received from the John Colbert Company, and A. Sherret at $4.30 per cwt. each,and for waterworks brass goods from the J. Colbert Company, at $2,520, E. G. Prior, at $2,757.90, and A. Sherret at $2,520. The contracts have not yet been given out.

## RAILWAYS—STEAM AND ELECTRIC.

**Nova Scotia**

HALIFAX.—Much damage has been done on the Sydney & Louisburg Railway by washouts.

**New Brunswick.**

ST. JOHN.—Representatives of the New Brunswick, Quebec and Federal Governments, the National Transcontinental Railway Commissioners, the Railway Commission, the Miramichi Lumber Company, the Alexander Gibson Manufacturing Company, the New Brunswick Lands and Power Company, and the Grand Falls Power Company, will meet in Ottawa on December 16, to discuss the proposal that the Grand Trunk Pacific Railway should operate its trains through the New Brunswick forest region by electricity, generated at Grand Falls on the St. John River. This matter was discussed in the New Brunswick Legislature last year, and the plan suggested as a means of protecting the valuable timber areas from fire.

**Quebec.**

MONTREAL.—Montreal Street Railway Company are about to commence the construction of the new $1,000,000 shops in the northern part of the city. The buildings will consist of car-building shops, machine shops, electrical and winding shops, blacksmith and paint shops, and a large building for the stores and material of the company.

MONTREAL.—On Saturday, December 4th, the first train over the new line of the Canadian Northern Railway between Quebec and Ottawa, left Quebec, reaching Ottawa early on Sunday morning.

SHERBROOKE.—It is thought here that the Grand Trunk Railway intends making Sherbrooke a divisional point.

**Ontario.**

OTTAWA.—The latest issue of the Canada Gazette contains notice of an application to incorporate the Ottawa, Montreal and Eastern Railway Company, which seeks authority to construct a line from Lake Megantic to Montreal, with power to construct a bridge or tunnel for railway purposes, vessels, and pedestrians, and to collect tolls, and thence through Hochelaga, Jacques Cartier, Laval, Terrebonne, Two Mountains, and Argenteuil counties, crossing the Ottawa river, and passing through Prescott, Russell and Carleton counties, to Ottawa city. Branch lines to Arthabasca, Victoriaville and Yamaska are proposed. The Quebec Colonization Railway Company seeks authority to build a line from Tadousac, north-westerly to a point between Lakes Chibougamou and Mistassini and thence to Hannah Bay, Ontario, with a branch from Mistassini to the National Transcontinental.

ST. THOMAS.—The special committee appointed to report on the requirements of the street railway in order to put the road in shape recommended that a by-law be submitted to care for the following: Purchasing two new single truck cars, $8,000; lowering the large two truck cars and adding equipment and windows to same, $2,000; repairs to six closed cars, $3,000; extending line on Elgin Street to Centre Street, $2,200; placing Ross Street line, Wellington to Forest Avenue on cement foundation and steel ties, $790; extending Ross Street line, Forest Avenue to Hemlock and placing it on concrete foundation, with steel ties, $5,200; placing Wellington Street, William to Ross, on concrete foundation, with steel ties, $4,500, a total of $25,690.

TORONTO.—The Grand Trunk have completed the 36-stalls for an engine-house at New Toronto, at a cost of $1,400 each, or a total of $50,400. In the spring another engine-house will be erected, at a similar cost.

TORONTO.—After twenty-eight days in court the case of Mr. M. A. Pigott against the Guelph & Goderich Railway Company for $500,000 was settled on Saturday and dismissed by Mr. Justice Britton, both sides paying their own costs, which approximately amount to $50,000. It is understood that the case was settled for $175,000.

**Manitoba.**

BRANDON.—Messrs. E. J. Gifford and H. J. Skynner again made application to the city council for a franchise for the establishment of a heating plant, also for a street railway, and power and light plant.

WINNIPEG.—On Monday next the C. P. R. will open the Pheasant Hills branch.

**Saskatchewan.**

CARLYLE.—Grading on the C. N. R. has been completed by Cowan's construction outfit to mileage 150, which is 113 miles south and west of Carlyle.

**Alberta**

LETHBRIDGE.—The question of a street railway for Lethbridge and neighborhood, has been the subject of much discussion here recently.

**British Columbia.**

VANCOUVER.—The British Columbia Electric Railway Company have just placed an order for 50 car tenders of the Watson type.

VANCOUVER.—General Manager Sperling of the British Columbia Electric Railway, on returning from England on Tuesday the 7th December, announced that the directors had passed six million dollars for expenditures. One large work to be immediately undertaken will be the erecting of a 20,000 horse-power steam auxiliary plant in Vancouver.

VANCOUVER. Nearly all the details of a project for building a subway between the Inlet front and the False Creek railway yards have been worked out by the local engineering staff of the C.P.R., and the work may be started next year.

## SEWERS, SEWAGE AND WATERWORKS.

**Ontario**

KINGSTON.—A cedar culvert will be constructed on North Street here at a cost of $1,600.

ST. CATHARINES.—The Water Commissioners have recommended the installation of a new 24-inch supply pipe from the reservoir. This would give a supply 2¼ times greater than that of the present main.

**Saskatchewan.**

SASKATOON.—Sewer and waterworks extensions to cost $160,000 will be made next year by this municipality.

**British Columbia.**

VANCOUVER.—Work is progressing favorably on a dam which the Quesnele River Hydraulic Gold Mining Company is building across the Swift River, 600 feet long and 45 feet high, for the purpose of bringing water to its properties on Quesnele River. The company will construct its 26-mile ditch system in the spring, necessitating two miles of five-foot diameter pipe. The balance will be ditch flume and tunnel. The company has about 300 men at work now, and Mr. H. B. Fergusson, of Burr & Fergusson, is the chief engineer.

## LIGHT, HEAT, AND POWER.

**Ontario.**

LONDON.—The agreement between the city council and the London Electric Company, for street lighting, mentioned in these columns last week has been ratified and the streets will be lighted on the sliding scale for a year.

TORONTO.—The municipalities of Milton, Port Credit, Mimico, Toronto Township and Brampton, all in Ontario, are seeking the service of the Hydro-Electric Power Commission. This means the establishment of another transformer station.

**Saskatchewan.**

SASKATOON.—The following schedule of rates has been recommended by the Light Committee:—From 1 to 100 k.w., 11 cents per k.w.; from 101 to 150 k.w., 9 cents; from 151 k.w. up, 8 cents, with a 10 per cent. discount if accounts are paid within 10 days. This was adopted.

SASKATOON.—The Saskatchewan Power Company have offered to supply the city with power at less than $30 per h.p. per annum for a twenty-four hour day.

**British Columbia.**

VICTORIA.—Work is being rushed on the clearing of the site for the new British Columbia Electric Railway power plant at Jordan River. Plans and specifications for the electrical and mechanical apparatus have been prepared, and a number of the leading manufacturers in the United States, Canada and Great Britain contemplate tendering. The machinery will cost several hundred thousand dollars.

## FINANCING PUBLIC WORKS.

The following municipalities have sold debentures:—Sarnia, Ont., $31,361; Maidstone, Ont., $11,921, drainage works; Lindsay, Ont., $25,000, schools and waterworks; West Zorra Township, Ont., $7,000; Sarawack Township, Ont., $25,000, schools; Adjala Township, Ont., $2,400, schools.

**Ontario.**

GUELPH.—The library board have asked that debentures be issued for $3,000.

HAMILTON.—The ratepayers will vote on the following by-laws; $200,000 good roads by-law; $50,000 police station by-law; $25,000 public library by-law; $26,000 registry office by-law.

ST. CATHARINES.—The ratepayers will vote on a $15,000 by-law for hospital funds.

LONDON.—The ratepayers of London will shortly vote on a garbage by-law.

WELLAND.—The ratepayers will vote on a pavement by-law in January.

**Alberta.**

LETHBRIDGE.—The ratepayers will vote on a $46,000 general purposes by-law.

FORT SASKATCHEWAN.—Tenders will be received up to Monday, December 27th, for $6,000 electric light debentures. Thomas J. Stacey, secretary-treasurer.

**British Columbia.**

NEW WESTMINSTER.—The ratepayers here will vote on a local improvement by-law.

VICTORIA.—Ratepayers here will be asked to vote on a $52,000 by-law to enlarge Ross Bay.

VANCOUVER.—The civic finance committee have endorsed by-laws calling for $1,374,000 for public works, which include school extensions $274,000; exhibition by-law, $80,000; park improvements, $50,000; park purchase, $334,000; fire halls, $35,000; juvenile house of detention, $20,000; clearing and rough-grading streets, $350,000; macadamizing streets, $150,000; supplementary by-laws for causeway across Coal harbour, $80,000.

## MISCELLANEOUS.

**Nova Scotia.**

HALIFAX.—Messrs. Swan & Hunter, the English shipbuilders, are sending an expert to Halifax to look into the cost of shipbuilding here. Bonuses aggregating $300,000 have been offered to any shipbuilding company erecting a plant on Halifax harbour.

**New Brunswick.**

ST. JOHN.—A party of surveyors sent out by the Government of Ottawa to survey the international boundary has concluded its labors for the season, and the members have returned to their homes in Ottawa, Toronto and Winnipeg.

**Quebec.**

MONTREAL.—The Canadian Rubber Company are planning extensive alterations to their plant here.

**Ontario.**

HARWOOD.—The Trent Canal engineering staff have moved up to Rice Lake, where some of them will put in the winter months surveying the lake.

LONDON.—Mr. E. I. Sifton, electrical engineer, will ask the council to engage a consulting engineer to check the tenders tabulated in connection with the awarding of power plant contracts.

LINDSAY.—The plans for the Wellington Street bridge will be ready in a few days.

TORONTO.—The city council are considering the installation of several garbage destructors.

**Alberta.**

CALGARY.—City Engineer Child has outlined plans for a bridge across the Elbow River.

TABER.—The last spike of a bridge spanning the Belly River, 1½ miles north of here was driven by the Hon. Archie McLean, M.P., on Saturday morning, November 27th. On May 1, 1908, Mr. P. W. Simons commenced work on the bridge, which consists of five concrete piers, each descending 25 feet from the water level, and resting upon a hard shale foundation. The four spans of steel in its construction are 712 feet in length, which added to the 459 feet of piled trestle gives it a total of 1,171 feet. The structure is capable of carrying a 25-ton traction engine, and contains a driveway of 18 feet, and has a clearance overhead of 14 feet. Twenty-eight feet six inches marks its height from top of floor to water level, and is 9 feet higher than any water mark known.

## PERSONAL NOTES.

HON. W. A. BUCHANAN, of Lethbridge, formerly of Toronto, will be appointed commissioner of municipalities at Ottawa.

MR. JOHN M. MOORE, who has been engineer in charge of the waterworks at London, Ont., for 16 years, resigned this week.

THE CANADIAN INSPECTION COMPANY, LTD., have removed their Toronto offices from 37 Melinda Street to Stair Building, corner of Adelaide and Bay Streets.

THE CANADIAN FAIRBANKS COMPANY, LTD., have been appointed exclusive sales agents in Canada for Dicks' Balata Belting, and have purchased the business of J. S. Young.

MR. C. H. NICHOLSON, traffic manager of the Northern Navigation Company, Collingwood, Ont., has resigned to accept a position with the Grand Trunk Pacific Railway as general manager of their Pacific Coast fleet. At present he will be located at Vancouver.

MR. THOMAS W. PATTERSON, a prominent railway contractor, has been appointed Lieutenant-Governor of British Columbia. Lieutenant-Governor Patterson is a native of Ayrshire, Scotland, and celebrated his 57th birthday on Monday. He was educated in Oxford County, Ont., and spent his early manhood in Bruce County, going to Victoria in 1885. In 1902 he was elected at a bye-election to represent Victoria City in the Legislature and was re-elected at the general election of 1903.

MR. G. E. GRAHAM, at present acting divisional superintendent of the C.P.R., at Fort William, is to be transferred to a similar position at Vancouver, according to a Winnipeg report. Mr. R. Armstrong, at present general freight agent at Fort William, is to be the new superintendent, and the present freight agent at Brandon is to be transferred to Fort William. Mr. J. S. Youngson, dining and sleeping car agent at Fort William, is to be moved farther west, and Mr. C. Mead, inspector at Port Arthur, will fill the vacant position. The changes are to take effect on 1st January.

MR. R. S. KELSCH, consulting engineer of the Montreal Light, Heat & Power Company, will likely be appointed to fill the position of chief engineer of the company, made vacant by the sudden death of Mr. W. McLea Walbank, vice-president and chief engineer. This choice is regarded as a very natural one, and the announcement of Mr. Kelsch's elevation will be favourably received by the engineering profession of Montreal. Mr. Kelsch, who is a Chicagoan, came to Montreal twelve years ago to collaborate with Mr. Walbank on the construction of the Lachine hydraulic plant, which was successful in spite of many difficulties. Afterwards he took office as independent consulting engineer, and was retained in that capacity by the Montreal Light, Heat

& Power Company. He has since worked up an extensive clientele, and is consulting engineer for the Winnipeg Street Railway, Quebec Railway, Light & Power Company, Ottawa Electric Company, Ottawa and Hull Power and Manufacturing Company, and the McCall, Ferry Power Company, Pennsylvania. Mr. Kelsch, who is 47 years of age is a member of the Canadian Society of Civil Engineers, past president of the Canadian Electrical Association, member of the American Institute of Electrical Engineers, and member of the Executive Committee of the Engineers' Club, of Montreal.

## SOCIETY NOTES.

**Canadian Society of Civil Engineers, Montreal.**—A meeting of the general section of the Canadian Society of Civil Engineers was held on Thursday, December 2, at 8 p.m. A paper on "Construction of Lethbridge Viaduct, Crow's Nest Branch, Canadian Pacific Railway," by Mr. C. N. Monsarrat, M. Can. Soc. C.E., was read by the author and illustrated by lantern slides.

**Canadian Society of Civil Engineers, Winnipeg Branch.**—The second annual dinner of the Manitoba branch of the Canadian Society of Civil Engineers was held in the Royal Alexandra on Wednesday evening, December 1st. There were about fifty engineers present, Mr. J. E. Schwitzer, a member of the executive committee, presiding in the absence of Colonel Ruttan. The toast list was a very brief one, and the speeches were also brief. A considerable portion of the evening was spent in social conversation both prior to and at the conclusion of the dinner. The list of toasts with the names of the various speakers was as follows: The King, proposed by J. E. Schwitzer; The Profession, with which there was coupled the name of Professor Brydone-Jack; Our Guests, proposed by C. H. Dancer; The Ladies, responded to by Paul Schioler. Special guests of the society were President George McPhillips, of the Manitoba Land Surveyors Association, and President Joseph Greenfield, of the Architects Association. Among the engineers in attendance were: W. L. Mackenzie, J. G. Legrand, M. Brodie Atkinson, A. E. Innes, C. W. Chivers, R. B. Pratt, J. C. Holden, W. Walton, J. A. Hesketh, D. A. Evans, H. C. Lett, I. Woodman, A. R. Dufresne, A. K. Gemmer, E. H. Harrison, H. Lumsden, Paul Schioler, H. F. McDonald, S. F. Peters, J. La Cour, T. R. Deacon, A. H. Aldinger, J. Greenfield, W. Percy Over, J. E. Schwitzer, E. Brydone-Jack, G. McPhillips, Stone Edelen, Thomas Turnbull, J. Smith, A. W. Garty, J. G. Glassco, D. F. Coyle, B. Ripeye, W. A. Duff, C. C. Chataway, J. M. Leamy, George H. Archibald, John D. Matheson, T. W. White, Donald A. Ross, J. N. Dillabough, W. G. Chace, Francis Sedziak, W. M. McPhail, A. Erickson, J. A. Douglas. Prior to the banquet the annual meeting of the society was held and the following officers were elected: Chairman for 1910, J. E. Schwitzer; executive, Messrs. Hesketh, Turnbull, and Dancer; secretary-treasurer, Professor Brydone-Jack; auditors, Messrs. Lee and Bowman; committee on papers, Messrs. Hesketh, Fetherstonhaugh, Harrison and Bayne; committee on research and investigation, Messrs. Brydone-Jack, Fetherstonhaugh and Wilson; committee on library, Messrs. Fetherstonhaugh, Woodman, Duff and McKenzie.

**Architects' Association, Winnipeg.**—The fourth annual banquet of the Manitoba Association of Architects was held last Thursday evening at the Grange Hotel, Winnipeg. Professor Brydone-Jack, of Manitoba University, in his reply to one of the toasts, touched upon a subject concerning which there had been much informal discussion previously—namely, the organization of a lecture class in architecture. Past President Greenfield presided at the banquet, and toasts were drunk to the King, our profession, the city, our sister societies, etc. The following officers were elected for the coming year: President, J. H. G. Russell; 1st vice-president, Wm. Fingland; 2nd vice-president, J. D. Atcheson; treasurer, G. W. Northwood; secretary, W. Percy Over. The following is the list of Winnipeg architects and guests who attended the banquet: W. B. Lait, W. H. Carter, J. Woodman, F. O. Fowler, E. Brydone-Jack, J. Greenfield, John Atcheson, G. W. Northwood, G. M. Black, E. H. Rodgers, H. B. Rugh, H. L. Chalmers, L. S. Hooper, William T. Davis, W. A. Elliott, Charles S. Bridgman, R. B. Pratt, S. F. Peters, G. F. Carruthers, J. H. G. Russell, W. J. Ireland, H. R. Linnell, W. P. Over, and William Fingland.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8714—November 2—Authorizing the C.P.R. to construct, maintain, and operate industrial spur across 3rd Street, town of North Bay, Ont.

8715—November 1—Dismissing complaint of J. F. Hunter, Brassevain, Man., against the C.P.R. as to the manner in which they handle local freight at that point.

8716—November 1—Dismissing application of Lees & Perrin, Limited, of Winnipeg, Man., for Order directing the C.P.R. to for all time maintain a siding on what was formerly Point Douglas Avenue, Winnipeg, Man.

8717—October 15—Directing the C.N.R. to forthwith make passenger station facilities at Howell, Sask., adequate and suitable to accommodate twelve persons.

8718—November 15—Dismissing complaint of the McCollom Lumber Company, of Winnipeg, Man., that the C.P.R. and C.N.R. overcharged the complainants on a mixed carload of lumber from Warroad, Minn., to Indian Head, Sask.

8719—November 22—Granting leave to the G.T.P. Railway for leave to connect its tracks with the tracks of the C.N.R. near 1st St. E., of 21st St., Edmonton, Alta.

8720—November 23—Recommending to the Governor-in-Council for sanction by-law passed by the Temiscouata Railway Company re spitting in cars and railway premises.

8721—November 22—Granting leave to the G.T.P. Railway to cross at grade, the track of the C.P.R. at Yorkton, District of Assiniboia, Sask.

8722—November 24—Authorizing the corporation of the city of Toronto, Ont., to construct a suitable sewer on Bathurst Street, under the tracks of the C.P.R., said city.

8723 to 8725 Inc.—November 23—Granting leave to the Bell Telephone Company to erect, place, and maintain, its wires across the track of the G.T.R. at public crossing, Mary Street, Chesley, Ont.; the P.M.R.R. at public crossing 300 feet west Glenwood Station, Ont., and the P.M.R.R. at public crossing Foundry St., Leamington, Ont.

8726—November 24—Granting leave to the C.N.Q. Railway to place its tracks and telegraph wires under the telephone and power wires of the Quebec, Jacques-Cartier Electric Company, and wires of the Bell Telephone Company in parish of St. Sauveur, County Quebec, P.Q.

8727—November 23—Granting leave to the Horton & McNab Telephone Company to erect, place, and maintain its wires across the tracks of the C.P.R. on Lot No. 9, 3rd Con. Tp. of Horton, Ont.

8728—November 24—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.N.R. 200 feet west of Bruderheim Station, Alta.

8729—November 24—Dismissing application of Adam Gordon, of Cowichan, B.C., for Order directing the Esquimalt & Nanaimo Railway to provide and construct a suitable farm crossing where the company's railway intersects his farm in Lot 18, R. 3, Shawinigan District, County Nanaimo, B.C.

8730—November 23—Directing that the C.P.R. construct, maintain, and operate a spur at mileage 84.8 (from Muskoka) on the Toronto-Sudbury branch of its railway, Township Bigwood, Sudbury District, Ont.

8731—November 23—Authorizing the C.P.R. to construct, maintain, and operate industrial spur in the village of Beausejour, Man., for J. L. Turner, and the Manitoba Glass Manufacturing Company, Limited.

8732—November 23—Authorizing the G.T.P. Railway to construct, maintain, and operate branch line of railway or spur on Blocks 13 and 14, River Lots 12 and 14, Edmonton, Alta.

8733—November 24—Granting leave to the Kaministiquia Power Company, Limited, to erect, place, and maintain its power lines across the track of the C.P.R. north of Victoria Street, Westfort, Fort William, Ont.

8734—November 24—Authorizing the C.P.R. to construct bridge No. 19.6 on its Farnham Section, over Richelieu River, P.Q.

8735—November 23—Amending Order of the Board No. 8735, authorizing the G.T.R. to construct overhead farm crossing bridge at mile post 125.12 of its line between London & Windsor, Ont., on the lands of A. M. Dickie, by changing the figures and letters "5 per cent." in the second line of the second paragraph of the said Order to "6½ per cent."

8736—November 25—Amending Order No. 6858, dated April 19th, 1909, authorizing the A. Q. & W. R. to operate its trains over its line of railway from mileage 19.75 to mileage 20.5 at the new station at Port Daniel, P.Q., by striking out clauses 1 and 2 in the operative part of the said Order.

8737—November 15—Extending for a period of thirty days from date of Order period within which the M.C.R.R. may have to widen the bed of the stream across the company's right of way under the trestle bridge at Bear Creek, one mile east of town of Petrolea, Ont.

8738—September 22—Amending Order of the Railway Committee of the Privy Council, dated December 3rd, 1892, in re crossing of the G.T.R. by the Davenport Street Railway at Davenport Road, by directing the Toronto Suburban Railway to install derails at crossing interlocked with semaphores; dismissing application of the Toronto Street Railway for Order reducing amount to be paid by them for the construction, operation, and maintenance of the crossing.

8739—November 17—Forbidding and restraining the Nipissing Power Company, Ltd., from erecting, placing, and maintaining its lines of wires for the conveyance of heat, light and power across the line of the Bell Telephone Company, between Powassan & North Bay, Ont.

8740—November 24—Directing the C.P.R. to lower its tracks where the same crosses Sutherland Avenue, Winnipeg, Man.

8741—November 20—Dismissing application of the settlers and residents of Ribstone, Alta., for Order directing the G.T.P. Railway to provide a spur connection and loading platform between Dunne and Chauvin, Alta.

8742—November 25—Extending until 1st February, 1910, the time for installation of interlocking plant at the crossing of the G.T.R. by C.P.R. at Drumbo, Ont.

8743—November 22—Limiting the speed of the trains of the C.P.R. passing over Durham Road, town of Walkerton, Ont., to a speed of ten miles an hour.

8744—November 22—Directing the C.P.R. to provide and construct a suitable shelter with platform in Village of Clark, Ont.

8745—November 25—Directing the C.N.R. to provide and construct a suitable crossing over its railway where the same intersects Lincoln Avenue, Municipality of Rosser, Man.

8746—November 19—Granting leave to the C.N.Q. Railway to construct its railway across the highways in parish of Beauport, County Quebec, P.Q.

8747—November 26—Granting leave to the G.T.P. Railway to appeal to the Supreme Court of Canada upon all questions of law arising re location of its line of railway throughout the town of Fort William, Ont.

8748—November 26—Rescinding Order of the Board No. 7320, dated June 18th, 1909, approving of plans of subway for C.N.R. proposed to be constructed at 22nd Street, Saskatoon, Sask., by directing that the city file new plans for approval of the Board.

8749 to 8751 Inc. November 25—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the track of the C.P.R. at three points in said province.

8752—November 26—Granting leave to the Dresden Rural Telephone System, to erect, place, and maintain its telephone wires across the track of the P.M.R.R. at Emmett, Township of Chatham, County Kent, Ont.

8753 and 8754 November 26—Authorizing the town of North Battleford, Sask., to lay and thereafter maintain a water main under the track of the C.N.R. at Victoria Street, also sewer mains at Victoria Street.

8755—November 25—Authorizing the C.N.O. Railway to place its lines and tracks across and to connect with the lines and tracks of the G.T.R. near Brooklyn, Ont.

8756—November 27—Granting leave to the Bell Telephone Company to erect, place, and maintain its underground wires across the tracks of the Montreal Terminal Railway at St. Antoine Street, Tetrauville, P.Q.

8757—November 25—Authorizing Chas. Lawrence, of Bentinck, Ont., to lay water pipe under the tracks of the Walkerton and Lucknow branch of the C.P.R. where the same crosses Durham Road, Township of Bentinck, Ont.

8758—November 27—Authorizing the C.P.R. to construct, maintain, and operate industrial spur for the city of Winnipeg, Man., in parish of St. Paul.

8759—November 27—Authorizing the C.P.R. to construct, maintain, and operate industrial spurs for the North Pacific Lumber Company, New Westminster, District, B.C.

8760—November 29—Approving and sanctioning location of the C.N.R. Company's line from mileage 0 to mileage 5 up the Fraser River from Yale, B.C.

8761—November 29—Authorizing the C.P.R. to divert road allowance between Sections 22 and 15, Township 8, R. 5, west of the Principal Meridian, Manitoba.

8762—November 29—Approving and sanctioning location of the V. V. & E. Railway Company's line of railway from Hope at station No. 1988-70, to station 3 20-7.5 to the boundary line between districts Yale and Westminster, B.C.

8763—November 29—Approving and sanctioning location of the C.N.O. Railway Company's line from the Rideau River, at mileage 5.3 to the boundary line between Townships of Goulbourne and Nepean, Ont.

8764—November 29—Granting leave to the Vancouver Power Company to cross "V" of the Seattle Branch of the Canadian Pacific Railway north of Huntingdon Station, in the municipality of Sumas, B.C.

8765—November 29—Granting leave to the Vancouver Power Company to cross the main line and a spur track of the Seattle Branch of the C.P.R. at Clayburn Station, Westminster District, B.C.

8766—November 29—Authorizing the C.P.R. to construct, maintain, and operate siding to the premises of R. West & Company, at mileage 14.75, London Section.

8767—November 29—Extending for thirty days from date of Order the time within which the M.C.R.R. and the P.M.R.R. Companies each install upon its own railway at highway crossing over the railways on the town line between Townships of Southwold and Dunwich, Ont.

8768—November 26—Directing the C.P.R. to provide and construct a highway over its line of railway at Mackey Station, Township of Head, Nipissing District, Ont.

8769—December 2—Authorizing the Canada Atlantic Railway Company (G.T.R.) to construct, maintain, and operate branch line of railway, or siding, from the tracks on the south side of Sappers Branch to and into the site of Hotel Chateau Laurier, now being erected in Majors Hill Park, Ottawa, Ont.

8770—November 29—Amending Order 8540, dated October 15th, 1909, approving plans and specifications of the municipality of Township of Colchester, North Ontario, re Pinkerton Drain, under the tracks of the M.C.R.R. by approving plans substituted for above mentioned plans.

8771—November 2—Authorizing the corporation of the town of St. Louis, P.Q., to lay and thereafter maintain a water pipe under the track of the C.P.R. where the same intersects Saoguinet Street.

8772—December 2—Authorizing the Chatham Gas Company to lay and thereafter maintain a gas main under the track of the G.T.R. at Degge Street crossing, Chatham, Ont.

8773—November 29—Granting leave to the municipal corporation of the village of Burlington, Ont., to erect, place, and maintain its electric wires and telephone wire under the track of the G.T.R., at Burlington Beach, Ont.

8774 to 8776—November 2—Granting leave to the Consolidated Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. near Upper Kent Station, N.B.; one mile south of Bath, N.B., across the C.P.R. at Bath, N.B., and at Bristol, N.B.

8777 and 8778—November 25—Granting leave to the village of Brussels, Ont., to erect, place, and maintain its wires across the track of the C.P.R. at intersection of boundary line between the Townships of Morris and Grey and the Gore of Grey and Goderich, at village of Walton, adjoining West Station, and across the track of the G.T.R. on its Wellington, Grey & Bruce line at intersection of Concession line between Concession 4 and 5, Township of Morris, Ont.

8779—November 29—Granting leave to the North Huron Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at point crossing near Whitechurch Station, Ont.

8780—December 1—Granting leave to the Caremont & Vilburn Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. on the 4th Concession, Writhy Township, Ont.

8781—November 18—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the C.N.O. Railway.

## MARKET CONDITIONS.

Montreal, December 9th, 1909.

From the United States come reports of renewed interest in pig-iron for delivery covering the second half of next year. A very large tonnage is now under negotiation and will likely result in business, as the furnace interests are in a position to calculate fairly accurately the cost of their next year's output. Foundries throughout the whole country are well supplied with orders and are looking forward to even greater activity from the beginning of the new year. Manufacturers of cast iron pipe are in receipt of heavy orders and are in the market for a large tonnage of pig to take care of their requirements. Steel-making grades are strongly held and an upward tendency is beginning to manifest itself in prices of basic iron which, during the past few weeks, has been on the weak side. The steel markets are still very strong and railways are placing contracts for rails, cars, locomotives, and other supplies which, coupled with heavy orders for structural work and expansions to steel plants, are giving manufacturers all they can do to take care of business in sight.

In England, prices have just held about steady during the past three or four weeks. A moderate business is passing in pig-iron and steel, but there is nothing doing in the situation to warrant any decided upward movement. Conditions in Germany and Belgium are more satisfactory, prices on all classes of iron and steel material, including pig-iron, showing moderate improvement. The German situation is strengthened by the fact that a considerable portion of the output of billets' crop-ends are being exported in quantity to the United States. The elections will have the tendency to keep business in suspense.

Conditions in the local market are very satisfactory. Dealers report good orders being received, for this time of year, and nothing to complain of. This is the period of the year when dulness generally prevails, but this year orders are coming to hand every day. The feeling among the trade seems to be that Canada was never in so hopeful a condition as at the present moment. The financial basis is all that could be asked, money is plentiful and there is little doubt that next year will see great industrial activity and a general expansion.

The local market for finished and semi-finished material continues in its previous groove. For some strange reason, price changes are almost entirely absent, yet everywhere else, advances seem to be taking place. In the case of cold rolled shafting, plates, sheets and bars, no alteration has taken place for a long time past. Manufacturers in the east, however, are advancing their prices to meet the west, and the mills across the border are so overcrowded with orders that they cannot make deliveries inside of six or eight weeks. Dealers claim that it is the English market that holds back local advances.

Following are this week's quotations:—

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14 1-2c. 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝ inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, ex-store, Montreal, prompt delivery; No. 1 Summerlee, $21.50 to $22 per ton; selected Summerlee, $21 to $21.50; soft Summerlee, $20.50 to $21; Clarence, $19.50 to $20; Carron, No. 1, $21.50 to $22, and Carron special, $21 to $21.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 15 to 45c. each, or a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c.

freight rate to Montreal Latha: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ½-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are firmer at $2.45 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged at 32½ to 33c.

**Zinc.**—The tone is steady, at 6 to 6¼c.

## CAMP SUPPLIES.

**Beans.**—Prime pea beans, $1.85 per bushel.

**Butter.**—September and October creamery, 26c.; dairy, 22 to 23c.

**Canned Goods.**—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 75 to 80c.; tomatoes, 82½ to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.30; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65.

**Cheese.** Late makes, 11½ to 11¾c.; finest makes, ½c. more.

**Coffee.**—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c.

**Dried Fruits.**—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6c.; California, seeded, 7½ to 9c.; Sultana, 8 to 10c. Evaporated apples, prime, 9¼ to 9¾c.

**Eggs.**—No. 1 candled, 26c.; selects, 29 to 30c.; new laid, 35c.

**Flour.**—Manitoba, 1st patents, $5.70 per barrel; 2nd patents, $5.20; strong bakers, $5.

**Molasses and Syrup.**—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 50c.; Porto Rico, 40 to 45c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case.

**Potatoes.**—Per 90 lbs., good quality, 50 to 60c.

**Rice and Tapioca.**—Rice, grade B., in 100-lb. bags, $2.95 to $3; C.C., $2.90. Tapioca, medium pearl, 4½ to 4¾c.

**Rolled Oats.**—Oatmeal, $2.45 per bag; rolled oats, $2.20, bags.

**Tea.**—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, greens, 25 to 50c.; low-grades, down to 15c.

**Provisions.** Salt Pork.—$30 to $32 per bbl.; beef, $15 per bbl.; smoked hams and bacon, 15 to 18c. per lb.; lard, 17c. for pure and 12c. for compound.

**Fish.**—Salted. Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to $1.25.

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Toronto, December 9th, 1909.

With the colder weather, the demand for building materials is weaker. Changes in prices have been practically confined to camp supplies, for for which some increases will be noted.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $0.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

**Boiler Tubes.**—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1¼-inch. 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2¼-inch, $10.60; 3-inch, $12.10; 3½-inch. $15; 4-inch, $18.50 to $19 per 100 feet.

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Demand is only moderate.

**Bricks.**—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

**Broken Stone.**—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The demand has been active for some weeks, and supply not equal to it; feeling is upward. Broken granite is selling at $3 per ton for good Oshawa.

**Cement.**—Manufacturers' prices for Portland cement are $1.40 without bags, or $1.70 including cotton bags for car lots on board car, Port William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand dropping off.

**Coal.** Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50.

**Copper Ingot.**—Demand quite heavy, and price advanced to 14¼c. Supply adequate.

**Detonator Caps.**—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

**Dynamite,** per pound, 21 to 25c., as to quantity.

**Roofing Felt.**—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

**Fire Bricks.**—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

**Fuses.**—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Repeat quotations of last week, as follows:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $11.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76, 4½-inch, $38; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

**Lead.**—Prices steady outside. This market is steadier, and demand quiet, at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is good.

**Lumber.**—Prices continue steady, and city demand quieter. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to 45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, weak, and rather over-stocked, $3 to $3.10; lath, No. 1, $4.40, white pine, 42-inch; No. 2, $3.75; for 32-inch, $1.60.

**Nails.**—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.15, in barrel lots, $2.[illegible]. Plasterer's, $2.15 per barrel of three bushels.

**Ready Roofing.**—Dealers report a large demand, the prices being as before, per catalogue

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7. There is still a scarcity of good slaters and much demand for them.

**Rope.** Sisal, 9[illegible]c. per lb.; pure Manila, 1[illegible]c. per lb., Base.

**Sewer Pipe.—**

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ..... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft long | .00 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions ..... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps ..... | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ..... | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business quieter; price, 2½ per cent. off list at factory for carload lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—We do not alter prices as yet; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a good demand exists, and there is prospect of higher prices.

**Sheets Galvanized.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24,

$3.25; 26, $3.40; 28, 3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. Demand very active.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "11.R.D." high speed tool steel, 65c.

**Tin.**—The feeling in tin is firm, and the price 32 to 33c. per lb.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and a large business is being done. Price very firm at $5.75 to $6 per 100 lbs.

### CAMP SUPPLIES.

**Beans.**—Hand picked, $2; prime, $1.90.

**Beets.**—85c. a bag.

**Butter.** Dairy prints, 21 to 22c.; creamery rolls, 27 to 28c.

**Canned Goods.**—Peas, $1.00 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; corn, 75 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Carrots.**—60c. and 65c. a bag.

**Cheese.**—Large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 9½c.

**Eggs.**—Cold storage, 26 to 28c.; new laid, 33 to 35c. per dozen, in case lots.

**Flour.**—Manitoba Flour.—Quotations at Toronto are:—First patents, $5.60; second patents, $5.10; strong bakers', $4.90; 90 per cents., Glasgow freights, 28s. 6d. Ontario Flour.—Winter wheat patents, for export, $4.20 to $4.25, in buyers' sacks outside.

**Lard.**—Tierces, 16c.; tub, 16 to 16¼c.; pails, 16¼ to 16½c. per lb., market firm.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Onions.**—$1.25 a bag.

**Potatoes.**—Best, 60 and 65c. a bag.

**Pork.**—Market uncertain. Short cut, $28 per barrel; mess, $26.50.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 13½ to 14c., tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 14½ to 14¾c.; breakfast bacon, 17c.; backs (plain), 17½ to 18c.; backs (peameal), 17½ to 18c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked. Market steady.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c

**Sugar.**—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

**Turnips.**—45c. a bag.

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Winnipeg, December 7th, 1909.

Winter weather has set in in earnest in Winnipeg, and outside activity is practically at an end for a few months. Consequently business with the supply dealers is quiet. The chief concern of the contractors now is the rushing of interior work. Plumbers and steamfitters are very busy, as apart from work on large buildings this is the season of the year when they have their harvest.

Lumber for finishing work is active and there is a great deal of finishing in Winnipeg to be done this winter. It is learned that some of the leading architects are already working on plans of large buildings to be erected next season, and the outlook generally for the coming year would seem to be very bright. The season just closed has been a splendid one for builders and contractors, and the feeling is that 1910 will be even better. There will be plenty of money available for new buildings, and dealers are placing large orders for early delivery.

Quotations on the local markets are as follows:—

**Anvils.**—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

**Beams and Channels.**—$3 to $3.10 per 100 up to 15-inch.

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in., $55; cull red or white pine or spruce, $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in., $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

**Building Paper.**—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No 2 tarred, 62½c.; plain, 56c.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $9.75 large lots to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $2 f.o.b., carload lots, $3 single ton; coke, single ton, $7 at yard; large lots special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton

**Copper Wire.**—Coopered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 8, $4.06; No. 12, $4.20, No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 4c per cent. discount.

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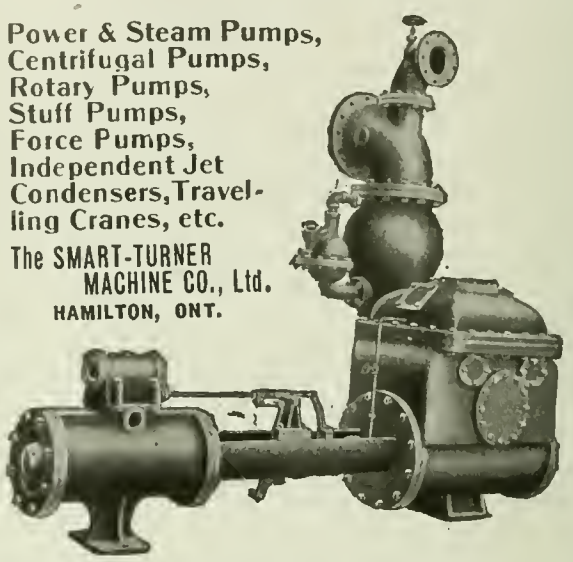

**Cement.**—$2.25 to $2.50 per barrel, in cotton bags.

**Chain.**—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards, 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

**Hinges.**—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

**Iron.**—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

**Nails.**—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

**Picks.**—Clay, $5 per dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb

**Pipe.**—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.25; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

**Pitch.**—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb; roofing pitch, $1 per cwt.

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c; sisal, 10½c.

**Spikes.**—Basis as follows.—1¼ 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 100 lbs.

**Timber.**—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

**Steel.**—8½ to 15c. per pound.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the Interests of the**

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**Editor**—E. A. James, B.A.Sc.
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TORONTO, CANADA, DECEMBER 17, 1909.

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## VOLUME XVIII.

With the issue of December 31st we will close Vol. XVII., and our first issue in January will commence a new volume. So many engineers now bind their copies of The Canadian Engineer that we feel warranted in making special mention of the new volume, knowing many more are anxious to add to their technical libraries by preserving their technical magazines.

During the first six months of 1910 we will have special series of articles dealing with

Railroad Location.
Gas Engine Design.
Practical Astronomy.

Machine Design and Operation.
Steel Bridge Design and Erection.
Concrete and Reinforced Concrete Construction.

Costs and Cost-keeping.
Legal Decisions Affecting Engineering.
Municipal Street and Park Improvement.

Critical Book Reviews.
Current Construction News.
Lists of Engineering Literature.

Market Conditions.
Railway Signalling.
Locomotive and Stationary Engine Design.

Railway Earnings.
Precipitation at Fifteen Centres.
Orders of Dominion Railway Board.

## ANNUAL MEETINGS.

During December and January the annual meetings of most of the technical societies will be held. New officers will be elected, reports adopted, and, this great effort over, we will go to sleep, in some cases, for another year.

A society is like a business. To be successful, someone must regularly, persistently and untiringly work for its advancement.

Look over the history of those successful societies you are familiar with, and you will find they are a "one-man organization." Somebody has made it his own personal business to arrange meetings, get after new members, and enthuse the membership. When he drops out, for a time things go on as before, but very soon the personal touch is lost and things drift.

Let us not be suspicious nor envious of the man who gives hours and hours of unselfish devotion to a public cause.

Technical associations are again like business ventures. To be successful they must give value for money received. No matter how venerable the name nor how

beautifully worded the first clause of their constitution, unless they are a working, living force they serve no purpose in the community, they damn the profession they are supposed to represent, and are a useless load to their members. It would be better to have no organization at all than a lifeless, purposeless one.

Every new movement has its day of "little things," but keep it growing, spend more money, open new departments, branch out—grow.

## TRAINING MECHANICS.

This is the day of the trained man. To be a leader to-day a man must be a specialist; but, more than that, if a man wishes to keep even a good place in the ranks he must be skilled and trained.

Competition is keen in the business world to-day—keener than it has been for years. The department manager must cut cost down to the very last fraction of a cent. He may do that by lowering wages or by reducing waste and increasing output. It is recognized that the trained mechanic, understanding his work and why he does it, interested and informed, will with the same effort produce better and surer results than the workman who is a mere machine.

The Grand Trunk Railway mechanical department recognized the value of trained mechanics years ago, and were pioneers in attempting to solve the problem of effectually supplying the demand for skilled mechanics. Their solution has appealed to heads of other large industrial corporations, and has been copied in whole or in part.

In a booklet, entitled "Training Modern Mechanics," issued recently, the Grand Trunk Railway tell how this great railway system solved the apprenticeship problem, and furinshed its own shop and those of many other large companies with master workmen and master mechanics.

The boy leaving day school, stepping out into the world to make his own way, must pass a physical test as to sight, hearing, writing, spelling and arithmetic. Having passed a satisfactory examination, he is then taken on under articles agreeing to serve faithfully four or five years with the company. Stripped of all its legal phraseology, "This Indenture" simply means the boy must work where he is put, and out of working hours do a certain amount of study, the company agreeing to pay him for his labor, provide instructors, class-room and courses of study, and foremen who will do more than exact toll, men who will take pleasure in instructing the apprentice.

The apprentice is encouraged, guided, rewarded. The company secure a loyal employee, a man who grows up to respect the company that educated him and made him more than a machine.

The working out of this system has taken years of study, adjusting and revision, but the results to the Grand Trunk Railway and to Canada have justified the effort.

## EDITORIAL NOTES.

We have sometimes wondered why members of the engineering profession do not take a more active part in the administrative departments of our country. Perhaps it is because in the ordinary routine work there is so little to do. It is interesting to notice that when the position of Lieutenant-Governor of British Columbia—a real, live position, where much is doing—is vacant, it is filled by an engineering-contractor—by a man who has always been busy doing things.

Lieutenant-Governor W. P. Paterson — railway builder—we extend congratulations.

* * * *

According to returns made under the Mining Act to the Provincial Bureau of Mines, the output of the metalliferous mines and works of the Province for the nine months ending September 30th, 1909, was as follows: Gold, 1,125 ounces, valued at $18,026; silver, 18,751,549 ounces, valued at $9,385,600; cobalt, 427 tons, valued at $79,450; arsenic, 780 tons, valued at $39,221; copper, 5,583 tons, valued at $740,677; nickel, 8,912 tons, valued at $1,921,363; iron ore, 205,262 tons, valued at $473,770; pig iron, 294,698 tons, valued at $4,095,735; zinc ore, 785 tons, valued at $8,000. The gross production amounted in value to $16,762,742, as compared with $12,185,511 for the first nine months of 1908.

## SOCIETY NOTES.

**Central Railway and Engineering Club of Canada, Toronto.**—The regular monthly meeting of the above club will be held in the Assembly Room, Prince George Hotel, on Tuesday, December 21st, at 8 p.m., when a paper will be read on "Gas Manufacture," by Mr. C. G. Herring, chief draughtsman, Consumers Gas Company, Toronto.

* * * *

**Canadian Society of Civil Engineers, Montreal.**—An ordinary meeting of the society was held on Thursday evening, 16th inst., when Mr. A. D. Swan, resident engineer, Montreal harbour works, gave a description, illustrated by lantern slides and cartoon drawings, of the construction of the new harbour, wet dock, and graving dock, at Bristol, England.

* * * *

**Engineers' Club, Toronto.**—At the Engineers' Club last Thursday evening Mr. A. Sothman, Dr.E., chief engineer of the Ontario Hydro-Electric Power Commission, took about sixty local engineers for a trip over the Ontario Government's transmission line, which will shortly supply Niagara power to the large towns and cities of south-western Ontario. Mr Sothman presented a map of the country affected, showing the route of line and the points it touches, following which lantern slides illustrating the progress of the construction work and the method of erecting the towers, the type of apparatus used and the lay-out of the different transformer stations were provided together with much information. Mr. A. B. Barry, C.E., presided.

## COMING MEETINGS.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton, H. Moore, Butte.

**American Association for the Advancement of Science.**—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

**American Society of Agricultural Engineers.**—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

## CONCRETE BRIDGE FAILURE

During the summer of 1909, there was erected on Concession B, Township Etobicoke, York County, Ontario, a concrete bridge. The reproduced photo gives some idea of the style of the structure.

The span was ten feet, making the opening through the bridge for the water ten by six. From the bed of the stream to the top of the concrete guard the height was about twenty-six feet so that when the roadway was filled in there was about thirteen feet of earth over the floor.

The reinforcement consisted of three-quarter inch plain rods placed two foot centres in the walls and twelve-inch centres in the floor.

After the bridge had been completed nearly two months and the thirteen foot fill over the floor completed the centres were struck and almost immediately the floor fell.

The accompanying photo gives a good idea of the break. The floor fell in, the horizontal crack in the face of the wall shows the depth of floor.

On examination the concrete appeared good being of correct proportion and had set well. The weakness appeared to be in the design.

A calculation made from measurements taken after the failure shows a stress of at least 41,500 pounds per sq. in. on the steel in the floor slab and a stress of 1,100 pounds per sq. in. in the concrete.

Cheeney Creek Bridge after failure

This certainly looks like a case where the design has been at fault.

Municipalities are slow in learning that they must employ competent engineers in connection with engineering work, and contractors familiar with such work are learning to leave work alone unless it has been designed by engineers known to be experienced.

Peat fuel for locomotives has been unsuccessfully experimented with by engineers of the Swedish federal railways. The fuel has proven too soft to form a proper fuel bed when fired alone. A type of firebox may be designed which will be more successful. If such a successful design should be evolved it is reported that the railways would place several peat-burning locomotives in regular service.

## CONTROL OF WORKMANSHIP ON ASPHALT PAVEMENTS.*

By L. Kirschbraum, Municipal Asphalt Laboratory, Chicago.

Undoubtedly there have been more failures on account of improper mixing and handling of good materials than in the use of inferior ones. To secure good results depends not only on laboratory inspection, but also upon trained inspectors at the asphalt plant when the mixtures are prepared and at the street where the materials are being laid.

Upon the establishment of an asphalt plant inspection bureau for the City of Chicago by the late Andrew Rosewater, M. Am. Soc. C.E., general instructions were issued to plant inspectors which read as follows:

Inspectors at asphalt plants are hereby instructed to take note daily of the materials used in the proportioning of paving mixtures, both as to their physical nature and the quantities, by measurements and weight.

It is desirable for the preparation and maintenance of proper records in connection with work, under contract with the city, to note the name and brand of each kind of material used, and in compounding mixtures to see them measured and weighed and observe, whatever proportions are used in the various mixtures, whether a uniformity is maintained, and if no uniformity or system is observed, to embrace such facts in the reports.

Contractors are expected to afford all necessary conveniences for such inspections. If obstacles are placed in the way of securing desired information, or facilities are denied by any contractor, the inspector must note same in his daily report, with the alleged reasons.

Samples of asphaltic cement used shall be sent daily to the laboratory for testing purposes, also the street surface mixtures. Separate samples of other materials called for by the chemist shall be taken for examination and test to the laboratory. Anything relating to materials received at the plant, or to operations in their mixture and handling, shall be noted on the daily reports sent to the laboratory.

* From a paper in the Michigan Technic.

In addition to these general instructions the points to be watched in preparing the mixtures may be set forth briefly as follows:

In the preparation of the asphaltic cement it is essential that the refined asphalt and flux be weighed into the kettles in such proportion as to produce the desired consistency. The temperature of the kettles must be regulated by the inspector within the limits which the asphalt cement in question can properly sustain. In combining, the flux and asphalt should be sufficiently agitated to produce thorough solution, and with asphalts containing much mineral matter, to avoid settling out of such, with consequent lack of homogeneity in the cement and resulting mixtures.

The consistency of the asphalt cement is varied to produce a hard or soft pavement, or to meet the requirements of a fine or coarse mineral aggregate. It is desirable, other conditions being the same, that for any piece of work the consistency be uniform to a standard which experience with each asphalt has demonstrated to be satisfactory. Consistency is determined by the penetration machine, which operates by measuring in tenths of a millimeter to depth of penetration into a sample of the cement at 77 degress F. of a No. 2 needle under a weight of 100 grams for five seconds. Where there are facilities for testing at the plants it is the duty of the inspector to test each kettle before use. When there are no such facilities an experienced inspector can determine an approximate consistency by chewing a sample of the cement. In any case, samples of each kettle are sent in daily to the laboratory for checking, and close control and record are kept of them.

Two kinds of binder are in use at present in the paving industry, an open and a closed binder, or asphaltic concrete. The open binder is made of well graded stone one and one half inch to quarter inch limiting sizes coated with asphalt cement. Asphaltic concrete, as the term implies, differs from the open binder in having the voids of the stone filled with an asphaltic mortar of sand and fine screenings, making a dense and compact medium. This is much superior to the open binder in its ability to support the surface rigidly and to prevent crushing of the top into the interstices of the binder under heavy traffic.

The main cause of trouble with open binder is overheating—not necessarily on account of injury to the cement, but because of the fact that the coating of cement will run off hot stone to such an extent that at the end of a long haul the top three-quarters of a load will be so devoid of cement as to be insufficiently bonded when laid, while the material in the bottom of the wagon contains an excess of "juice," making it difficult to rake, and forming, when rolled, "a grease spot."

(To be Continued.)

## SOME CHARACTERISTICS OF CEMENT BRICK

Although cement brick (or concrete brick) construction is still in its experimental stage enough is known to demonstrate that under favorable conditions it may be a strong competitor of clay brick in both price and appearance.

The extensive use of cement brick by the Plymouth Cordage Company, Plymouth, Mass., has demonstrated several valuable facts. For the construction of their new mill having an aggregate wall length of nearly one fifth of a mile, almost two and one-half million cement bricks were made upon the ground.

The mixture used in the major part of the work was 3 parts sand to 1 part cement. A few bricks were made of 4 parts sand to 1 cement for lightly loaded walls. The brick used on the outside of the buildings had a facing (⅛ inch thick after compression) of 2 parts fine sand and 1 part cement, with the addition of 2 per cent. waterproofing (by weight) to the cement. Enough water was used to make a mortar of such consistency that it would hold its shape under compression, without flushing water to the surface so as to cause the mortar to stick to the plates. No definite percentage can be given as to the amount of water, as that is governed largely by temperature and atmospheric conditions, but the average amount was about 8 per cent.

**Table 1. Absorption of Cement Bricks.**

| Brick | Weight. Dry. lbs. | oz. | Saturated. lbs. | oz. | Absorption. oz. |
|---|---|---|---|---|---|
| Face | 5 | 8½ | 5 | 10 | 1½ |
| Common inside | 5 | 8 | 5 | 11 | 3 |
| Facing material* | 5 | 0½ | 5 | 10 | ½ |
| Hard burned body clay brick | 4 | 11 | 5 | 7 | 12 |

**Table 2. Tests of Cement Bricks.**

Test "A". Face brick; body 3 parts sand to 1 part cement; facing, 2 parts fine sand to 1 part cement; 2 per cent. waterproofing compound added to cement by weight. Facing ⅛ inch thick after compression.

| Age, days | 1st Crack, lbs. | Ultimate strength, lbs. | Per sq. in., lbs. |
|---|---|---|---|
| 56 | 87,100 | 87,100 | 2,730 |
| 120 | 100,900 | 108,650 | 3,400 |
| 239 | 128,500 | 132,650 | 4,145 |
| Test "B". Common brick; 3 parts sand to 1 part cement. | | | |
| 56 | 69,750 | 71,200 | 2,215 |
| 92 | 95,000 | 99,100 | 3,080 |
| 120 | 119,700 | 119,700 | 3,735 |
| 239 | 129,000 | 134,100 | 4,095 |
| 275 | 162,100 | 164,600 | 5,160 |
| Test "C". Common brick; 4 parts sand to 1 part cement. | | | |
| 56 | 74,150 | 76,500 | 2,390 |
| 120 | 89,050 | 91,450 | 2,810 |
| 239 | 119,500 | 126,400 | 3,905 |
| Test "D". Common brick; 5 parts sand to 1 part cement. | | | |
| 56 | 72,150 | 72,150 | 2,240 |
| 120 | 80,700 | 86,650 | 2,675 |
| 239 | 110,000 | 119,950 | 3,710 |
| Test "E". Two hard-burned "body" clay bricks. | | | |
| ... | 101,000 | 150,000 | 4,770 |
| ... | 94,000 | 162,000 | 5,470 |

Care in curing the brick (that is, constant wetting), will overcome to a large degree any minor weakness which is theoretically developed by a "dry mix."

To the uninitiated, the small quantity of water used would seem likely to produce a porous brick having a strong attraction for water, with damp buildings as the result of their use. As a matter of fact, these bricks do not absorb water to any great extent. Bricks 30 days old, carefully dried and then submerged in water for 16 hours, showed the results given in Table No. 1.

Table No. 2 shows the results of tests made under the direction of the Ordnance Department of the United States Army at the Government Arsenal in Watertown, Mass. The figures are averages unless otherwise noted.

*Brick made entirely of the material used for facing the outside brick.

(Continued on Page 672.)

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## TO THE STUDENT AND OTHERS.

The Sanitary Review wishes to say a few words to the student.

No diploma, certificate or degree can ever make you less qualified to be a student than you are now. Any diploma, certificate or degree simply stamps you as a student, and should act as an incentive to further knowledge.

He who believes that he has attained to the utlimate of knowledge in any subject, chews the cud of his own ignorance.

An engineer who obtains what are termed qualifications and establishes a practice, may consider that his whole efforts are only justifiably spent in earning fees, but he has forgotten that he is an engineer.

He who schemes out a piece of work, and cannot see how and where he could improve it after completion, has stopped dead in the march of evolution, and he is no longer a student.

The beauty of knowledge lies in its teaching of the reality of limitations, and the possibility of reducing limitations.

Beware of the so-called "scientist," who says: "I have discovered a new principle, but the discovery is my secret." He simply cannot explain the new principle, because it does not exist.

Beware of the man who makes a mystery of his profession, for all mystery is quackery and a cloak for ignorance.

The man who looks very wise, shakes his head and says: "I know, but I just cannot explain it; in fact, you would not understand if I did," is on a par with the toy nodding mandarin, and can only hypnotise the weakling by the profundity of monotony.

Never consider your knowledge on any subject as final; to do so is to imagine a point with both length and breadth.

He whose brain has created a fixed circumference has created an imaginary line into a false reality.

A man must be both a teacher and a student; he teaches that which he thinks he knows, and learns that what he teaches he, after all, only thinks.

Do not argue to prove that you are right; that is egotism. Be the champion of your subject only.

Do not attempt to improve another man's mind. That is the action of a conceited prig. You have nothing to do with the other man's mind. Try and improve the sum total of knowledge.

To be a student to start with, to be a student to go on with, and to be a student to end with, is to live and breathe. To be content in knowledge is to cease to be a student, and means stagnation and development of human fungus.

## SEWAGE DISPOSAL.*

### REMOVAL OF PUTRESCIBILITY.

### Chapter VIII.—Choice of Filter Material.

Having in previous chapters dealt with the question of methods of distributing sewage over the surface of a filter, it is now proposed to deal more particularly with the material required for filtration purposes in its relation to removal of putrescibility.

It has been said that the problem of artificial biological filtration depends upon substituting in lieu of soil a material which will retain within itself sufficient oxygen to treat the sewage and yet pass off large volumes of liquid. Soil, because of the smallness of its pores, presents too small an air retaining capacity in proportion to its water retaining capacity in order to effect efficiency in purification at high rates of filtration.

Generally speaking it may be said that any sort of hard material not liable to disintegration is suitable for sewage filters. The continued efficiency of a filter certainly depends more upon non-liability to disintegration than to any other factor. The author has in mind a case where laminated sandstone was used as the filtering media, the result being that the material rotted in a short time into soft shale producing a fine sand which clogged up the base of the filter in eighteen months. Any sort of material which is easily affected by the action of frost or is subject to serious water erosion is entirely unsuitable.

It will be at once seen that the success of a biological filter depends largely upon the choice of filter material, and as the material required forms as a rule the most expensive portion of the whole scheme, especially if there is no suitable material at hand, there is a great inducement to utilize and put up with almost any handy material, granted that such can be obtained locally.

Given what may be looked upon locally as a fairly good hard stone, it is difficult to persuade a municipality to pay freight for furnace slag or green trap rock from any distance yet in every case it will ultimately pay to obtain just the very best material if such can be obtained within practicable limits.

Apart from the hardness and imperishability of the material, another factor, that of surface area, is of great importance.

We have seen in previous articles that the action of a percolating biological filter is three-fold, viz., "mechanical straining," "absorption," and subsequent "oxidation" or "nitrification."

The action of mechanical straining does not appear to be of so great importance as that of absorption and nitrifica-

* Prepared specially for the Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

tion; and the amount of nitrification depends largely upon the amount of organic matter absorbed, or the power of the filtering media to hold back and retain in the body of the filter organic matters in solution or colloidal form.

We have further seen that the absorptive power of a filter is dependent on the growth of a gelatinous film, which gradually covers the superficies of the filter material. Now the greater the area of the superficies of the material, the greater will be the area of the absorptive film and consequent efficiency in absorption of dissolved organic matter. This, however, is only one point in consideration relative to the choice of a rough rather than a smooth surfaced material. It will be obvious that a filter composed of pebbles, say about walnut size, will provide an air space area about equal to a filter composed of furnace slag of about the same size; however, the water retaining capacity of the former will be much less than the latter, owing to the smooth sides of the pebbles providing very little friction to flow, and consequently sewage will drain through pebbles at much quicker rates than through slag with a corrugated surface. Hence it is possible to provide a material which will give a too rapid rate of passage to the sewage to allow of efficient absorption.

This is a most important point relative to the choice of material as it may indirectly affect the depth of the filter beds. If only material of a smooth surface character can be obtained, and relatively large air retention capacity is required, then it will be absolutely necessary that the filters be deep and not shallow. For example, other conditions being equal a good hard furnace clinker may allow of an efficient depth of three feet, whereas with pebbles giving an equal air retention capacity per cubic yard twelve feet depth of filter would be required in order to produce an equal amount of absorption and consequent removal of putrescibility from the sewage.

Before planning out a system of biological filtration the engineer should know exactly the character of filtering material available for his purpose; and must not make the mistake, so often done, of planning out a definite character of work and size of plant, and then finding out that only at an enormous freight expense can he obtain a filtering material suitable to the arranged depth of filter.

The method sometimes adopted of inserting in a smooth surfaced material filter, a layer of coarse sand or other such finer material to arrest the downward flow liquid passage, is radically bad in principle and effect. Such inserted finer graded layers of material should never be necessary, and only serve as a means for clogging the filter and interrupting air circulation. The only change in size of material in a filter bed which is permissible is from a small grade to a large grade commencing from the surface of the filter downwards; and this applies more especially to laying a larger sized material around the sub-drains to facilitate drainage and aeration. Apart from the bottom layer, the best constructed filters are those which have a uniform sized material throughout, with occasionally a thin surface layer to assist in the distribution of the sewage over the surface. However, when the mechanical method of distribution is satisfactory, this finer upper surface layer should be ignored, as it tends to prevent effective aeration.

With reference to the comparative efficiency of certain materials, it will be well here to quote from the British Royal Commission on Sewage Disposal (5th Report). The Commission carried out experiments at York (England) to determine the purification effected in the same sewage liquor by clinker, broken brick, blast furnace slag, and gas coke. The filter was 100 feet diameter, 7 feet 8 inches in depth ond divided into segments, the sewage liquor being continuously supplied by a revolving sprinkler at a rate of 140 gallons per cube yard of filtering media per day. Hourly samples of the effluents were taken from each of the four segments over three complete days after the filter had been in work twleve months. Purification was effected in the order of merit as follows:—

(1) Clinker.
(2) Coke.
(3) Slag.
(4) Broken brick.

The Royal Commissioners state:—

"These experiments tend to confirm the view that the extent of the purification effected by a percolating filter depends upon the length of time taken by the sewage to pass through the filtering material, assuming always that the filter is properly aerated. Having regard to the vesicular nature of the clinker we should expect it to retard the passage of the sewage more than the broken brick, and hence to give a better effluent. The analytical results show that this was the case."

Professor Dunbar (Principals of Sewage Treatment) publishes some interesting experiments which substantiate the theory that a rough material is more suitable than a smooth one. He carried out simultaneously experiments with the same crude sewage on both gravel and coke filters with varying sizes of material.

Gravel 2-3 m.m. size as compared with coke gave a reduction percentage of oxygen absorbed of 52.8 as against 67.7 with the latter. Again gravel 10-20 m.m. size gave a reduction percentage of oxygen absorbed of 44.7 as against 48.7 with similar coke.

It must be concluded that with reference to the removal of putrescibility from sewage, that given equally imperishable material, a rough surfaced material is much more efficient than a smooth surfaced one, and that less filtering depth is required with the former than with the latter.

When we come to discuss the size of material most suitable., although it is admitted that a small sized material will present a greater absorbing surface than a larger sized material, the main factor however is one of mechanical filtration or straining.

Broadly speaking, the finer the material used in the bed of the filter, the purer the effluent will be; the finer the material the slower will be the rate of filtration, and the finer the material the shorter will be the life of the filter. This practically means that if we required an effluent on a par to that obtained by slow sand filtration in water supply plants, we should have to follow similar principles, with the exception that the filter area would have to be enormous as compared with water treatment, and men would be constantly employed removing and washing the surface layer of sand.

The size of material being subject to the question of mechanical straining, it is obvious that it must depend upon the preliminary efficiency in removal of suspended solids. The greater the proportion of suspended solids left in the sewage liquor, the coarser must be the filtering media, with a consequent diminution in removal of putrescibility.

It is obvious then that no hard and fast rule can be laid down as to size of material. Many factors must be taken into consideration, such as the quality of the suspended matter and its liability to settle out by sedimentation. Many failures have been made in biological filtration work, by basing the size of material with reference to some other works without comparison of relative data. This is an error that the amateur or inexperienced engineer is very apt to fall into.

Among the main factors affecting size of material may be noted—the method adopted of removal of solids. If, for instance, septic tank settlement is relied upon it will be found

that if septic action is allowed to go on indefinitely, that the amount of suspended solids will increase in the settled liquor by even 100 per cent., so that a size of material which may have been effective in the earlier stages of the tank action may be wholly inadequate to treat with the increase of solids and so result in a clogged filter.

One of the great difficulties in treating septic liquor in biological filters is this consequent increase of solids, and it is for this reason that attention is now being universally drawn to improved methods in immediate removal of sludge from contact with the supernatent liquor, so as to obtain a constant amount of solids in the settled liquor.

Where removal of putrescibility only is required, without any very high degree of purity, continuous flow sedimentation tanks will be probably adopted, as they require little attention apart from the regular removal of settled solids before putrefaction commences. As we have seen in previous articles on "Removal of Solids," given a definite character of sewage, and a certain velocity and period of flow in a tank, a fairly constant removal of solids can be obtained from an average domestic sewage of from 60 to 70 per cent. The 40 to 30 per cent. of remaining suspended solids being of a fine character can be satisfactorily dealt with in a biological filter with a coarse material.

When a greater degree of purity is required than above, quiescent sedimentation, that is, allowing the sewage to stand without movement in tanks for about two to three hours, will precipitate from 70 to 80 per cent. of the solids, and allow of a finer filtering material being used, resulting in a purer effluent.

When an even greater degree of purity is required, and it is intended to treat the liquor in a very fine material and produce a high class effluent, it is necessary to add a coagulant such as sulphate of alumina, lime or other reagent to the raw sewage, by which means over 90 per cent. of the suspended solids can be removed.

Assuming a domestic sewage representing a strength equal to about 30 gallons per head per day water supply on the separate system of sewerage for a water closet town; with an approximate analysis in parts of 100,000 of four parts ammoniacal nitrogen, oxygen absorbed in four hours 12 parts, suspended solids 30 parts, we may approximately conclude for the removal of putrescibility as follows: If 50 per cent. of the solids are removed three inch diameter material may be used at a rate of 100 gallons per cube yard, allowing a life period to the filter of from 10 to 15 years.

If 60 per cent. of the solids are removed, then three inch diameter material—150 gallons—life of filter ten to fifteen years. If 70 per cent. of the solids are removed, then three inch diameter—at 200 gallons—life of the filter from ten to fifteen years.

Filtering material as used for biological filters may be classed (as per the Royal Commission Report) into coarse, medium and fine. Coarse material represents diameters of 2½ inches to 3 inches. Medium ½ inch to 1 inch. Fine ¼ inch to ½ inch. The fine material should not be used except in cases of secondary filtration or in connection with a high degree of removal of solids by aid of a coagulant.

In all cases in treating sewage for the removal of putrescibility by biological filtration, the author is strongly of opinion that it is easy to err in adopting too fine a material, and that even if a high degree of purity is desired, it is much better to first treat the sewage liquor on coarse filters, and then continue the treatment on finer grade filters as secondary treatment, rather than attempt a very high degree of removal of solids in the first instance with a view to direct treatment in fine filters.

The question of the removal of solids, as we have seen, is a very important one indeed, in fact in many cases the whole success of a plant depends upon its efficiency, but just as soon as the engineer departs from the principle of natural unaided sedimentation by reduction of velocity flow, he is face to face with working methods which entail large sums in maintenance, and generally interfere with automatism and simplicity.

(To Be Continued.)

## THE QUALITY OF EFFLUENTS IN RELATION TO STANDARDS.*

By Gilbert John Fowler, D.Sc., F.I.C.

(Continued From Last Week.)

The production of green growths, generally consisting of oscillatoria nigra, a green chlorophyllous alga, characterized by the vibratory movements of its filaments, is generally considered as evidence of satisfactory purification. The influence of sunlight seems to determine to some extent whether oscillatoria or carchesium appears chiefly in an effluent. A green organism (probably spirogyra) can, in fact, be seen developing at the Withington works just at a point where the outlet carrier is most freely exposed to the sun; the writer has also noticed that these green growths attain great luxuriance at certain effluent outfalls he has had experience of in India. Luxuriant growths of waterweed may also take place in some cases and become troublesome. . . .

The production of fungoid growths is, indeed, a very sensitive index of pollution, and it is possible, as the example just cited shows, to differentiate between varying sources of pollution by the character of growth developed This was pointed out years ago by Santo Crimp, but it is doubtful whether the subject has received as much attention as it deserves in the meantime; thus it is well known that small leakages of unpurified sewage passing direct into the land drains of irrigation areas, may produce disproportionately large amounts of fungus, the species depending on circumstances. The growth of fungus in land drains may depend also on the character of the land and of the effluent applied to it, if—e.g., iron is present in the latter, there is a great liability to the development of crenothrix, a filamentous organism which collects large masses of hydrated oxide of iron around it. The effluent from the Birmingham Sewage Farm, according to Mr. Watson's description, had to be screened before passing into the river in order to remove this kind of debris.

Mention has been made of a few of the more typical organisms likely to come under the eye of the sewage works manager, and readily recognized either by inspection or by examination under a low-power microscope. There are, of course, countless other flora and fauna which are characteristic of different stages of purification, and their complete investigation will afford occupation for biologists for many years. Good work has already been done by Marsson, Hofer, and others on the Continent. According to Hofer, the self-purification of rivers is in the main a transmutation of dead organic matter into living organisms, and he shows that a river purifies itself more rapidly in a succession of still pools than when the water is broken. He cites several interesting cases showing the dependence of organic growths on specific pollution; thus the sewage fungus sphaerotilus natans requires small quantities of sugar for its growth in quantity, and consequently large volumes of tannery waste containing much organic matter do not cause a development of this organism, whereas small quantities

of household sewage or brewery waste produce an abundant growth. It also requires much oxygen, and grows, therefore, best in broken streams. Finally, it needs constant sustenance with small amounts of sugar, and, therefore, a continuous small stream of polluting liquid furthers the growth more than large quantities at infrequent intervals. It is better, therefore, that discharges of effluent should under these circumstances be held up, say, for twenty hours and discharged all together in a short time. . . .

The labors of the scientific biologist can be considerably assisted if those in charge of sewage works would keep systematic records of the more characteristic developments occurring under specific conditions—e.g., of composition of sewage, time of year, temperature, etc. . . .

Careful accumulation of facts is necessary before a conclusion can be reached as to the best means of dealing with these growths when they occur. They can be temporarily arrested, of course, as has been shown, by sterilization. Such a process, however, is costly and open to objection, on the ground of its possibly deleterious effect on the normal life of streams, especially if used at all carelessly. On the other hand, there can be no doubt that many fungoid growths form excellent habitats for larvæ, small worms, such as tubifex, and probably numerous forms of crustacea. The development of gnat larvæ, indeed, is a matter of rather serious moment. This has been carefully watched in connection with the effluent from the percolating filter at Davyhulme already mentioned, and at certain periods of the year gnats appeared in objectionable numbers at the manhole covers of the closed channel through which the effluent passed. The development from the larval to the insect stage has been followed in the laboratory. These forms of life, however, may constitute excellent food for fish, and at the Berlin sewage fields large ponds have been constructed, into which the final effluent flows, together with a stream of fresh water, and in which carp and other coarse fish attain large sizes.

It is now generally recognized that the provision of some kind of tank to arrest deposits from percolating filters is necessary, and the Royal Commission suggest a similar provision in the case of contact beds. It is worth consideration whether this idea might not be developed and such tanks extended to form aquaria. Careful management would be essential in order, by the growth of aquatic plants or otherwise, to maintain an adequate supply of dissolved oxygen.

When this suggestion was made in the paper read at Leeds, certain subsequent critics appeared to think that it could hardly be seriously intended. Apart, however, from its adoption on a very large scale in Berlin, other successful applications of the same methods are cited by Hofer, with actual figures as to the weight of fish produced. A careful study by Marsson of the flora and fauna of a sewage works also leads up to the suggestion that when an effluent is so far purified that small crustacea can live in it, it is then most suitable as a source of food for fish.

It is possible, as pointed out by Sir James Crichton Browne, in his address to the Hygienic Section at the International Congress of Applied Chemistry, that considerable diminution in the bacterial content of effluents would result from such storage, on the analogy of Dr. Houston's observations in connection with the storage of drinking water. The cost of storage might be partly met by the value of the fish produced, and in any event the complete cycle from offensive organic matter through mineral matter and back again to organized life would be under control, instead of, as is at present the case, allowing the effluent to pass direct into the stream with all the possible contingencies which may arise. The suggestion of an aquatic sewage farm has already been made by Dr. Letts, in connection with the ulva nuisance in Belfast. There are probably many cases where analogous provisions might without great difficulty be made at inland sewage works. A typically suitable case would be where land of an impervious character could be excavated for a pond, and where a portion of a fresh-water stream could be diverted through the pond along with the effluent. Such a method might be considered the equivalent of final land treatment.

The general argument of this paper leads, therefore, to the following conclusions:—

1. That the standards suggested by the Royal Commission are, with possible slight modifications, the most practicable and adaptable of any yet suggested.

2. That where the self-purifying power of the body of water receiving the effluent is high, they may be too stringent.

3. That effluents may pass these standards and yet develop considerable growths at the outfall.

4. That the final treatment of effluents in large and well-aërated, scientifically managed ponds can in many cases be advantageously adopted.

5. That careful and continuous research is necessary in order more fully to determine the different links in the cycle of nature, upon conformity with which efficiency and economy in the disposal of the waste products of human life must ultimately depend.

## FRAZIL.

The approach of winter recalls the fact that the frazil and anchor ice season is again at hand. It will be interesting to hear what has been accomplished at Hull, Quebec, and Ottawa, Ont., during the last few years in connection with the problem of preventing frazil from shutting down the hydro-electric plants at these places and demoralizing the electric light, industrial power and electric railway services which are supplied from them.

We are informed that some forty water wheels in the power district at and near Ottawa are now equipped with heating devices, which prevent frazil from stopping the wheels and clogging the gates and gate-operating mechanism. The Ottawa and Hull Power and Manufacturing Company, which supplies Ottawa's city distributing system, and also the International Cement Works with power, increased the capacity of its generating station this year, and while this work was in progress it also increased the capacity of its frazil-combatting plant, which has been in successful operation during the last three years. A 30 horse-power boiler was formerly employed, and the new equipment consists of a 100 horse-power boiler, which, it is anticipated, will supply an ample amount of steam to keep the plant in operation in the face of frazil attacks, while the output of the station is as high as 10,000 horse-power. An interesting feature of the latest 3,000 horse-power unit at this station is the arrangement of the water wheels and their controlling gates for heating purposes. The chutes and gate chambers have been cored out, and have pipe connections to the openings, so that steam or hot water may be kept circulating through them when frazil is anticipated.

The power houses of the Ottawa Electric Railway and of the Ottawa Electric Company are also equipped with water wheel heating systems, and these plants have had similar satisfactory experiences to those of the Hull company during the last two and four winters, respectively.

(Continued on page 673.)

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### COST OF CITY PAVEMENTS.

The following tables of costs were given by C. H. Rust, city engineer of Toronto, Can., in a paper before the convention of the American Society of Municipal Improvements at Little Rock, Ark.:—

**Cost of Asphalt Paving on Sackville St., Toronto, Canada.**

(Medium asphalt, 5-in. concrete, 1-in. binder and 2-in. surface, with 16-in. gutters.)

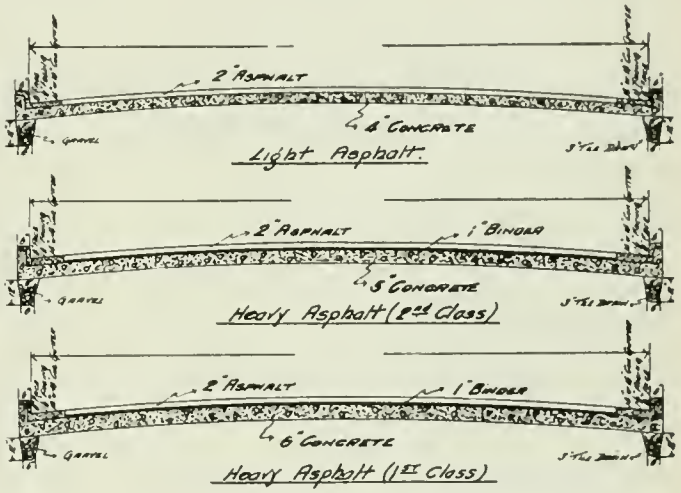
| Pavement. | Total. | Per Sq. Yd. |
|---|---|---|
| Grading (1,815.5 sq. yds.): | | |
| Labor | $ 321.29 | $0.176 |
| 45 hrs. roller at $1.40 | 49.00 | 0.027 |
| Total | $ 370.29 | $0.203 |
| Foundation (1,815.5 sq. yds.): | | |
| Labor | $ 141.44 | $0.078 |
| Materials: | | |
| 255 bbls. cement at $1.34 | $ 342.00 | |
| Cartage at 8.4 cents. per bbl. | 21.42 | |
| 341.8 tons stone at $1.27 | 441.87 | |
| Cartage | 118.96 | |
| 160 cu. yds. sand at 90 cts. | 144.00 | |
| Total materials | $1,069.15 | $0.588 |
| Total labor and materials | 1,210.59 | |
| Deduct for foundation under gutters | 160.43 | |
| Actual total labor and materials | 1,050.16 | $0.666 |
| Surface, 1 in. Binder, 2 ins. Tops (1,651 sq. yds.): | | |
| Labor | $ 70.50 | |
| 18 hrs. roller at $1.40 | 25.20 | |
| Total labor | $ 95.70 | $0.058 |
| Materials: | | |
| 153 batches binder at $1.98 | $ 301.00 | |
| Cartage | 24.95 | |
| 275 batches tops at $2.70 | 742.50 | |
| Cartage | 36.15 | |
| 175 lbs. asphalt cement at 1.87 cents | 3.24 | |
| 400 lbs. stone dust at 0.3 cents | 1.20 | |
| ½ cd. slabs at $6 | 3.00 | |
| Total materials | $1,112.48 | $0.674 |
| Total labor and materials | 1,208.18 | $0.732 |

| Gutter. | Total. | Per Lin. ft. |
|---|---|---|
| (1,366 lin. ft. 16 x 3 ins.): | | |
| Labor | $ 23.92 | $0.018 |
| Materials: | | |
| 25 bbls. cement at $1.34 | $ 33.50 | |
| Cartage at 8.4 cts. per bbl. | 2.10 | |
| 6 cu. yds. sand at 90 cts. | 5.40 | |
| 10,175 tons granulith at $3.50 | 32.30 | |
| Cartage | 3.33 | |
| 34.5 cu. yds. concrete foundation | 160.43 | |
| Total materials | $ 237.06 | $0.173 |
| Total labor and materials | 260.98 | $0.191 |

| Header. | | |
|---|---|---|
| 72 granite sills at 70¼ cts. | $ 5.05 | |
| Foundation (labor and concrete) | 5.05 | |
| Total | $ 10.10 | |
| Miscellaneous Expenses. | | |
| Foreman and watchmen | $ 68.75 | |
| Cleaning street | 8.00 | |
| Carting and placing planks | 4.33 | |
| Tools | 41.98 | |
| Water for 280 bbls. cement at 4 cts. per bbl. | 11.20 | |
| Office expenses | 41.98 | |
| Total | $ 176.24 | |
| Misc. charges per sq. yd. pavt. | | $0.09 |
| Misc. charges for sq. yd. gutter | | 0.01 |

**Cost of Laying 496.4 Sq. Yds. of Asphalt Paving and Building Concrete Curb and Gutter on Broadway Place, Toronto, Canada.**

(Light asphalt pavement 18 ft. wide and 543.7 ft. long Estimated cost, $2,801; city tender, $1,793. Began May 27th and completed June 19th, 1909.)



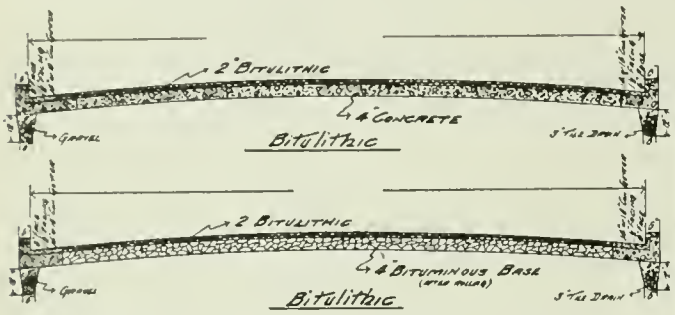

Pavements.

| Grading: | Total. | Per Sq. Yd. |
|---|---|---|
| Labor | $ 339.13 | $0.359 |
| Foundation: | | |
| Labor | 83.86 | 0.089 |
| Materials: | | |
| 144 bbls. cement at $1.32 | $ 188.76 | |
| Cartage on cement at 9 cts. per bbl. | 12.87 | |
| 75 cu. yds. sand at 92 cts. | 69.00 | |
| 172 tons stone at $1.29 | 221.88 | |
| Cartage, 50 cts. per ton | 86.00 | |
| Tota' materials | $ 578.51 | |
| Less $116.21, as below | 116.21 | |
| Actual totals | $ 462.30 | $0.488 |

| Surface (area 950.4 sq. yds.) | | |
|---|---|---|
| Labor | $ 16.00 | $0.017 |
| Materials: | | |
| 150 batches asphalt at $270 | $ 405.00 | |
| Cartage on asphalt | 31.13 | |
| 300 lbs. stone dust at 30 cts. per 100 | 0.90 | |
| 50 lbs. asphalt cement at $1.87 per 100 | 0.94 | |
| ½ cord wood at $5.10 | 2.55 | |
| 5 hrs. roller at $1.40 | 7.00 | |
| Total materials | $ 447.52 | $0.471 |
| Total labor and materials | 463.52 | 0.488 |
| Grand total for pavement | 1,348.81 | *$1.424 |

Curb and Gutter.

| Grading: | Total. | Per Lin. ft. |
|---|---|---|
| Labor | $ 97.51 | |
| Tile on tile | 10.10 | |
| 20 cu. yds. sand at 92 cts. | 18.40 | |
| 1,000 tile at 2 cts. | 20.00 | |
| Total grading | $ 145.91 | $0.134 |
| Lumber: | | |
| Labor | $ 32.71 | $0.030 |
| Concrete: | | |
| Labor | $ 47.40 | $0.043 |




| Materials: | | |
|---|---|---|
| 31¼ bbls. cement | $ 42.38 | |
| Cartage on cement | 2.87 | |
| 13 cu. yds. sand | 11.24 | |
| 8.64 tons stone at $1.29 | 11.15 | |
| Cartage on stone at 50 cts. | 4.12 | |
| 6.9125 tons granolith at $3.50 | 24.20 | |
| Cartage on granolith | 3.35 | |
| 201.4 sq. yds. 4-in. concrete at 57.7 cts. | 116.21 | |
| Total materials | $ 215.52 | $0.198 |
| Total labor and materials | 262.92 | 0.241 |
| Grand total for curb and gutter | 441.54 | *0.405 |

Headers.

| | Total. | Per Sq. Yd. |
|---|---|---|
| Labor | $ 2.97 | $1.46 |
| Materials: | | |
| ½ bbl. cement | $ 0.70 | |
| 56 granite blocks at 70 cts. | 3.92 | |
| 2 cu. yds. sand at 92 cts. | 1.84 | |
| 2 sq. yds. 4-in. concrete at 57.7 cts. | 1.15 | |
| 2 sq. yds. grading at 36 cts. | 0.72 | |
| Total materials | $ 8.33 | $4.165 |
| Total labor and materials | $ 11.30 | *$5.65 |

*To this amount must be added the proportion of miscellaneous charges given under "Miscellaneous Expenses."

Miscellaneous Expenses.

| | | |
|---|---|---|
| Foreman and watchmen | $ 56.25 | |
| Office expenses | 28.01 | |
| Tools | 28.01 | |
| Water for 175 bbls. cement at 4 cts. | 7.00 | |
| Cleaning up street | 21.92 | |
| Labor on culverts, extra | 3.00 | |
| Total | $ 144.19 | |
| Misc. charges per sq. yd., pavement | | $0.100 |
| Misc. charges per lin. ft., curb and gutter | | 0.032 |
| Misc. charges per sq. yd., header | | 0.396 |

**Cost of Laying 809.2 Sq. Yds. of Bitulithic Pavement on Alhambra Ave., Toronto.**

(Pavement 24 ft. wide and 303.5 ft. long on 4-in. concrete, with 16-in. gutters and 6-in. concrete curb.)

Pavement.

| Grade: | Total. | Per Sq. Yd. |
|---|---|---|
| Labor | $ 183.85 | $0.252 |
| Foundation, 1:3:7 Concrete: | | |
| Labor | $ 66.03 | $0.091 |
| Materials: | | |
| 116 bbls. cement at $1.32 | $ 154.42 | |
| Cartage at 6.6 cts. | 6.50 | |
| 125 tons stone at $1.29 | 161.35 | |
| Cartage at 43 cts. | 53.75 | |
| 62 cu. yds. sand at 95 cts. | 58.90 | |
| Total materials | $ 434.92 | |
| Less 124.1 sq. yds. in curb and gutter | 73.47 | |
| Actual total materials | $ 361.45 | $0.501 |
| Total labor and materials | 427.48 | 0.592 |
| Surface: | | |
| Labor | $ 35.56 | |
| 9 hrs. roller | .12.60 | |
| Total labor | $ 48.16 | $0.065 |
| Materials: | | |
| 719.4 sq. yds. bitulithic at $1.15 | $ 827.31 | |
| Cartage | 64.31 | |
| 5 gals. oil | 0.50 | |
| Total materials | $ 892.12 | $1.240 |
| Total labor and materials | 940.28 | 1.308 |
| Grand total pavement | 1,551.61 | *2.152 |

Curb and Gutter.

| Grading: | Total. | Per Lin. ft. |
|---|---|---|
| Labor | $ 34.26 | $0.056 |
| Fences | 14.49 | 0.025 |
| 100 ft. tile | 2.00 | 0.003 |
| Total grading | $ 50.75 | $0.084 |
| Concrete Curb (1:3:5 mixture): | | |
| Labor | $ 8.56 | $0.014 |
| Materials: | | |
| 5 bbls. cement at $1.32 | $ 6.65 | |
| Cartage at 5.6 cts. per bbl. | 0.28 | |
| 4½ tons stone | 5.80 | |
| Cartage | 1.93 | |
| 2 cu. yds. sand at 95 cts. | 1.90 | |
| Total materials | $ 16.51 | $0.027 |
| Total labor and materials | 25.07 | 0.041 |

| | | |
|---|---|---|
| Facing (1:1:3 Granulithic): | | |
| Labor | $ 10.00 | $0.018 |
| Materials: | | |
| 10 bbls. cement at $1.32 | $ 13.20 | |
| Cartage | 0.59 | |
| 6¼ tons granolith at $3.50 | 21.95 | |
| Cartage | 5.57 | |
| 3 cu. yds. sand at 95 cts | 2.85 | |
| Total materials | $ 44.10 | $0.073 |
| Total labor and materials | 54.10 | 0.089 |
| Foundation: | | |
| 124.1 yds. 4-in. concrete at 59.2 cts. | $ 73.47 | $0.121 |
| Grand total curb and gutter | 203.45 | *0.335 |
| Header. | | |
| Labor | $ 4.75 | $1.583 |
| Materials: | | |
| 75 setts at | $ 5.06 | |
| 1 cu. yd. sand at 95 cts. | 0.95 | |
| 2½ bbls. cement at $1.32 | 3.30 | |
| Cartage | 0.14 | |
| 2¼ tons stone at $1.29 | 2.90 | |
| Cartage | 0.96 | |
| Total materials | $ 13.31 | $4.436 |
| Total labor and materials | 18.07 | 6.019 |
| Miscellaneous Expenses. | | |
| Foreman | $ 54.65 | |
| Office expenses | 25.21 | |
| Tools | 25.21 | |
| 134 bbls. water for cement at 4 cts. | 5.36 | |
| Cleaning up | 30.48 | |
| Total | $ 140.91 | |
| Misc. charges per sq. yd. pavement | | $0.17 |
| Misc. charges per lin. ft. curb and gutter | | 0.03 |

*To these amounts there are to be added miscellaneous charges as given.

## AN EXPERIENCE WITH CEMENT-LINED PIPE.

In recent paper, Leonard Metcalf, consulting engineer, of Boston, cites the experience of the city of Waltham, Mass., in the use of cement-lined pipe, which, though now abandoned, was in use long enough to present some very interesting results as here presented.

Waltham had a population in 1905 of 26,282. Waterworks were constructed in 1872, the mains being cement-lined pipe. In 1887 the further use of this pipe was practically abandoned, and since that time substitutions have been made until at the present time there is left only about one mile of cement pipe. In 1887 there were about twenty miles of cement-lined pipe, ranging in size from 4 inches to 16 inches.

The reason given for giving up the use of this pipe was leaks in the joints; also trouble in making connections and care necessary in opening and shutting gates to prevent water hammer, which is liable to cause breaks.

On July 4th, 1879, lightning caused the destruction of 300 feet of 6-inch pipe, cast-iron being substituted at a cost of $203. July 12th, 1883, lightning again caused a small leak, and it was repaired at a cost of $20. August 3rd, 1889, 32 feet of 4-inch pipe was destroyed, and on August 12th, 1891, 1,070 feet of 6-inch pipe was destroyed by lightning.

The Waltham report for 1895, contains reference to electrolysis in connection with the cement-lined pipe, and states that several pieces dug up near the electric car tracks were badly pitted, and that the pipe was rendered practically worthless

| Year. | No. of leaks in cement-lined pipe. | Total No. of leaks | Cost of repairs on cement-lined pipe. | Cost per mile. | Cost per mile. |
|---|---|---|---|---|---|
| 1883 | 13 | 19 | $ 232 00 | $17 84 | $11 60 |
| 1884 | 15 | 27 | 245 00 | 16 33 | 12 25 |
| 1885 | 6 | 13 | 45 00 | 7 50 | 2 25 |
| 1886 | 7 | 12 | 400 00 | 57 15 | 20 00 |
| 1887 | 5 | 12 | 154 00 | 30 80 | 7 70 |
| 1888 | 8 | 10 | 179 00 | 22 38 | 8 95 |
| 1891 | 37 | 41 | 1,092 00 | 29 52 | 54 60 |
| Average | 13 | 19.1 | $ 353 30 | $25 79 | $16 76 |

During this period there were about twenty miles of cement-lined pipe in the system

The large number of leaks noted in 1891 was partly due to the beginning of construction of a sewerage system in the city. Laborers in digging trenches for sewers caused damage to the water pipes. It should be noted that the cost of repairs given in the above table generally includes the substitution of cast-iron for the old cement-lined pipe.

Brockton, Mass., has a 20-inch and 24-inch pipe, about three miles long, one-half of it running through a country district, the remainder through one of the outlying streets of the city. The latter half of the main has numerous connections. The original pipe shell was dipped in hot asphaltum and rolled in cement and sand before being placed. The lower end of the main is under about 50 pounds pressure.

1908.—Superintendent states that there has been no trouble to speak of with this main during the twenty-eight years of its existence.

Concord, Mass., 1908.—Has two 10-inch pipes, approximately 2½ miles each in length, the first in the year 1874, and the second in the year 1883. Both pipes are still in active service, and have given comparatively little trouble from leakage. The maximum static pressure is aproximately 40 pounds.

## COST OF SUBWAYS, NEW YORK AND PARIS.

| | New York Subway. | | | Paris Subway. | | |
|---|---|---|---|---|---|---|
| | Amount. | Per mile of single track. | Per cent. of total cost. | Amount. | Per mile of single track. | Per cent. of total cost. |
| Total cost of construction | 61,338,000 | $1,432,000 | 100 | $62,252,000 | $1,000,000 | 100 |
| Total cost of equipment | 26,600,000 | 999,000 | 69.8 | 42,100,000 | 676,000 | 67.6 |
| Total cost of subway and equipment | $87,938,000 | 433,000 | 30.2 | 20,152,000 | 324,000 | 32.4 |

## THE FUNCTION OF THE AIR AND CIRCULATING PUMPS.

**Walter Smith***

Of recent years engineers have evinced considerable interest in the improvement of the design and efficiency of the condensing plant. This may be attributed to the advent of the steam turbine and the very high vacuum required to obtain economical running with this type of plant. Another reason for this improvement is the more general adoption of condensing apparatus which nowadays is becoming more and more necessary and in some cases absolutely essential, as, for instance, in many modern power stations. These stations for many reasons are situated a considerable distance away from the towns which they supply and they consequently have a very limited supply of fresh water for boiler feeding purposes, in which case a condensing plant is installed, the amount of water then required being only that lost by leakage and other sources of waste. But even when a plentiful supply of water is available it seems that engineers are beginning to look upon the condensing plant more in the light of a necessity than as a refinement or an additional complication. Of course in considering the relation between condensing plant and locality the ease of obtaining the necessary circulating water has to be borne in mind, but there are so many various types of condensers, some of which require but a small amount of water per lb. of steam per hour that when used in conjunction with a cooling tower there should be little difficulty in obtaining suitable apparatus for almost any particular case.

With this cursory glance at the present aspect of the condensing plant we must leave the condenser out of the question and confine our remarks to the air and circulating pumps.

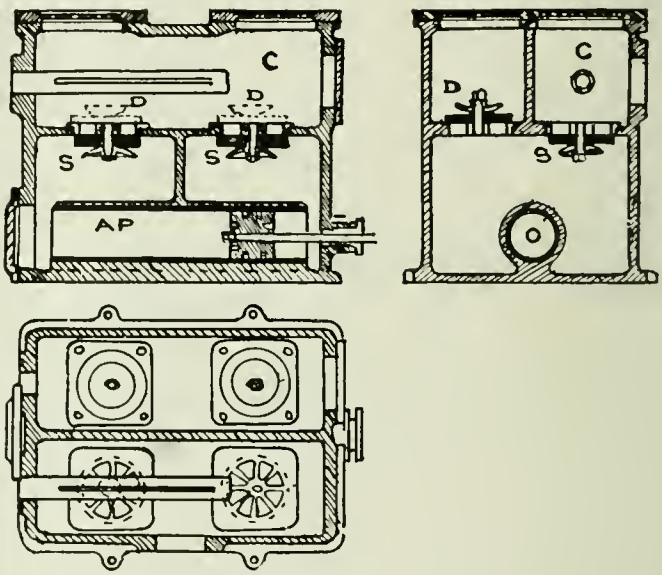
As the name suggests the air pump is used for exhausting the air from the condenser, but this is not its only function, for it also pumps out the condensed steam and water vapour. In the jet condenser, which is now almost obsolete, it not only pumped out the water condensed from the steam, but also the injection water. This placed the air pump of that time at a considerable disadvantage in places where pure and soft water was not available for use as injection, as, for instance, in marine work, where the boiler feed was taken from the hotwell. This water was practically as salt as the sea water which was used for injection, the sea water and the exhaust steam being in the proportion of about 30 to 1 weight. This, to a great extent prevented the use of boiler pressures much above 30 lb., and it was also necessary to periodically blow off a portion of the denser water in the boiler so that it could be supplied with a fresh supply of sea water and so prevent the water in the boiler becoming saturated.

With the introduction of mild steel plates and improved methods of construction, higher boiler pressures became general, and the question of using fresh instead of salt water became a serious one. This led to the introduction of the surface condenser, the great advantage of which consists in its providing feed water free from salt in solution. This is effected by keeping the cooling water and exhaust steam entirely separate, but even with surface condensers air pumps are necessary, but they may be made much smaller than would be the case with a jet condenser of the same capacity, as a considerable amount of air is brought in with the injection water.

*Institute of Marine Engineers Ritchie Award Prize Essay

Air pumps are always of the reciprocating type and are usually vertical in action, even when worked by horizontal engines, as this type is found to be more efficient than the horizontal, which is usually of the double acting solid piston variety. A pump of this type is shown in Fig. 1, working with a jet condenser, the whole being of very simple design and construction. C is the condensing chamber and SS are the suction valves and DD the discharge valves, there being two of each of the indiarubber type. The air pump, AP, is fitted with a gunmetal liner, in which works the solid piston fitted with two rings of hemp packing. The next figure (No. 2) shows a vertical single acting bucket pump arranged for working from the L.P. crosshead of a marine engine.

The action is as follows: — On the up stroke of the bucket, B, a vacuum is formed in the pump chamber, C, causing the air and water to flow in through the foot valves, F, owing to the higher pressure in the condenser. On the down stroke the air and water are forced through the bucket valves, A, until the bottom of the stroke is reached, when the cycle is repeated and the contents of the pump discharged through the head valves into the hotwell; at the same time a fresh charge is drawn in as at first explained.

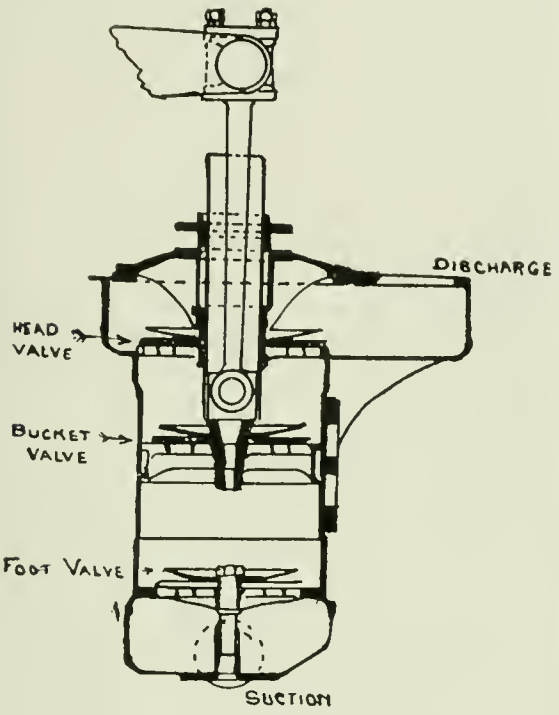



Mention must next be made of the "Edwards Patent Air Pump," its distinctive feature being the absence of foot and bucket valves, head valves only being required. The pump is of the vertical single acting type, and the water flows by gravity from the condenser into the base of the pump, then on the down stroke of the bucket the water is projected silently through the ports in the pump barrel into the chamber above the bucket. The up stroke is now commenced and the bucket in rising closes the ports and discharges the air and water through the head valves. It will also be noticed that as soon as the ports are open there are clear air inlets, the water following immediately afterwards has the slight effect of an injector and so carries in more air than would otherwise be the case, thereby slightly increasing the vacuum.

Another point that contributes to the high efficiency of this pump is that top clearance is reduced to a minimum. This is obviously very important, for before any air pump can discharge, the pressure in the pump must be greater than that of the atmosphere, and consequently all air remaining in the pump is compressed. Now when the bucket descends the pressure is reduced and the air in the clearance water is given off and expanding occupies space which should really be available for a fresh supply from the condenser

But efficient as is the Edwards pump there has, during the last few months, sprung up a tendency to fit very elaborate pumping equipment in turbine installations. This is due, as before mentioned, to the increased efficiency of the turbine with increased vacuum. In a paper by the Honorable C. A. Parsons, and G. G. Stoney read before the Institution of Civil Engineers the increase in efficiency was given as follows:—

"On a test of a 1,500 kilowatt turbine plant at two-thirds the normal output, the effect of an increase of an inch of vacuum at 26 inches is to diminish the consumption by about 4 per cent., at 27 inches by 4½ per cent., at 28 inches by 5½ per cent., and between 28 inches and 29 inches by 6 to 7 per cent. A good vacuum is thereby seen to be much more essential for the turbine than the reciprocating engine. This is shown diagrammatically in Fig. 3, which represents the combined indicator cards of a good triple-expansion engine, working with a vacuum of 25 inches. Now if we were to




increase the vacuum in the case of the reciprocating engine to 28 inches, the extra energy obtained from the steam is represented by the area of the black portion of the diagram marked R horizontally and dp vertically, while in the case of the turbine an increase of vacuum from 25 inches to 28 inches would mean that extra energy would be obtained equal to the area of the strip of the black portion of the diagram marked dp as before but T horizontally, or in other words the dp × R portion produced to T which will be seen to be a much more considerable portion than in the case of the reciprocating engine.

To maintain this high vacuum there have been introduced two new appliances, namely the "Dry Air Pump" and the "Vacuum Augmenter." The object of the "Dry Air Pump" is not so much to obtain a good vacuum as to maintain it, as no matter how carefully the condensers, pipes, etc., are erected there is always the liability of air leakage which would at once mean loss of power, therefore an air pump running at a comparatively high speed and dealing with a large volumetric area was considered to be necessary, and so we have the Dry Air Pumps.

This pump works in conjunction with the ordinary air pump, on the suction side of which a large air vessel is fitted; the suction of the Dry Air Pump being taken from the top of this air vessel, and is fitted with a special valve which ensures that air and vapour only may reach the "Dry Air Pump." Under ordinary conditions the Dry Air Pump runs at normal speed, but should difficulty be found in maintaining the vacuum owing to a leak or other contingent reason the speed is increased until the original vacuum is obtained. A small quantity of fresh water is kept circulating in the pump for cooling purposes. The Vacuum Augmenter is

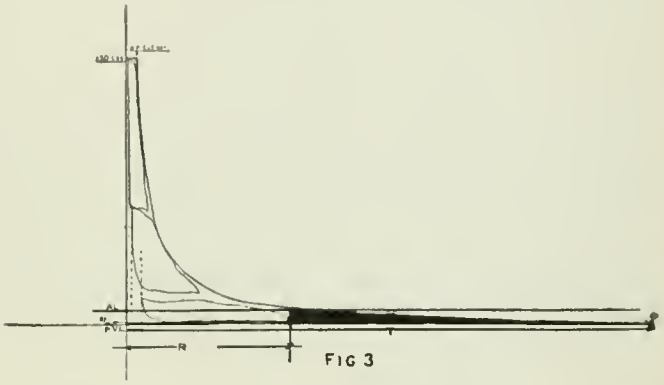


FIG 3

connected between the air pump and the condenser and consists of a small steam jet placed in the contracted portion of a pipe which leads from the bottom of the condenser to a cooler. The jet draws the water from the condenser and through the cooler to the air pump, so reducing the air to a very small amount.

Before closing the subject of air pumps it is necessary to mention one or two of the different types of valves in more or less general use. At one time vulcanized indiarubber was used without exception, it being especially prepared to resist the action of the oils. When used for naval work the composition was as follows: Oxide of zinc 70 per cent., sulphur, 13¾ per cent., the remainder being best caoutchouc. But nowadays although often used, indiarubber is rapidly giving place to metal valves, the best known type being the Kinghorn, shown in Fig. 4. These valves are made of thin phosphor bronze about 1/32 to 1/16 inch thick, there being three plates to each valve, and one on top of the other, of gradually decreasing diameters. They are made to fit loosely on the guide spindle so as to be perfectly free to rise and fall, and it will be noticed that the two bottom plates have holes in them about 3/16 to ¼ inch diameter, there usually being three to four in number drilled at different radii; this allows the valves to come back on their seats quicker and with less noise than would otherwise be the case. Another type of valve in considerable use is that known as the Beldam and which consists of a currugated brass plate about 1/16 inch thick with a valve guard corresponding in shape.

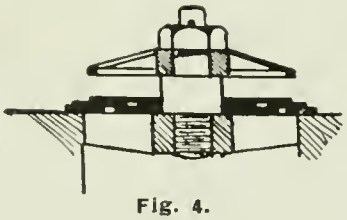


Fig. 4.

We now pass to the circulating pump, Fig. 5, which in marine work is either of the double or single acting piston type or the centrifugal pump. If the piston type of pump is fitted it usually forms part of the main engine, being driven by means of levers from the L.P. crosshead; but in a few cases it is independent, it then being of the direct-acting steam-driven type. Centrifugal pumps are always

direct coupled to a high speed steam engine. The independent circulating pump has many advantages over the main engine driven type, for instance, when the main engines are stopped the independent pump may be kept going and so keep the condensers cool.

In many cases where the pump is worked off the main engines it has been found necessary to arrange connections from one of the independent auxiliary pumps to the condenser for circulating when the ship is stopped. Another advantage of the independent type is that when fitted with a bilge suction, which is usually the case, they can be used to pump out the ship in case of emergency. The reciprocating type of pump may be either single or double acting and the stroke is usually about one half that of the main engines. The suction and delivery valves are of the same type as used in air pumps, being either of rubber or metal. The plunger is made solid and is nowadays fitted with water grooves in preference to hemp packing.

The work that the circulating pump is called upon to do is very light, there being usually no lift, as the discharge is almost always under water, so that we have only the friction of the pipes and the work required to keep the water in motion. Under such conditions the centrifugal pump is found to work admirably, it being specially adapted to deal

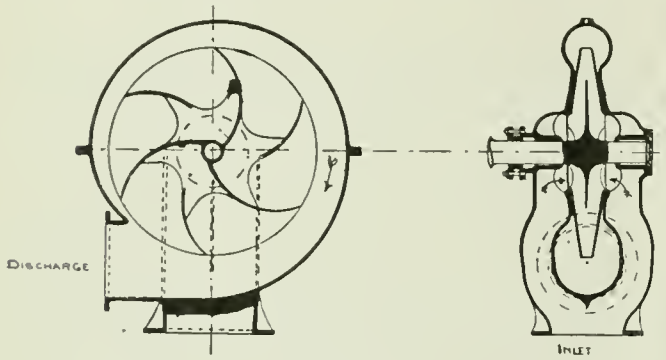



Fig. 5.

with large volumes at small lifts. It has no valves and consequently there can never be dangerous strains put on the pumps or pipes, for should the discharge inadvertently become blocked, the impeller would simply churn the water. With such points as these to recommend it we cannot wonder that it is rapidly gaining favor on both land and sea.

The pump is very simple, consisting as it does of an impeller mounted on a shaft which is directly coupled to the shaft of the engine or motor from which it obtains its power. This impeller works inside a casing of gradually increasing area in the direction of rotation. In this casing are cast the suction and discharge branches. The water enters the impeller at the centre, either from one or both sides, the latter being almost always the case. Should, however, the water enter from one side only, it sets up an unbalanced axial thrust on the wheel, which must then be taken up by means of thrust collars. The impeller is made of brass or gunmetal to resist the action of the water, and consists of two side plates, tapering from the centre to the extreme radius, between which runs a central rib to guide the water into the vanes which are cast between the side plates and extend from the boss to the circumference.

These vanes are curved away from the centre in the opposite direction to rotation and are designed so that the water enters the impeller with the least shock. The shaft on which the impeller is mounted is made of gunmetal or steel cased with gunmetal, the impeller being keyed on. There are two bearings, one at either end fitted with lignum vitae bushes which are lubricated by the water. At the end of the outside bearing there is fitted a brass cap, the impeller shaft not passing right through. This ensures water tightness. The inside bearing is, however, more complicated, as in this case the shaft passes right through; it is therefore necessary to fit the bearing with a gland and stuffing box, sometimes a gunmetal bush is fitted inside the gland to take the wear.

This bush is split to allow of renewal without taking out the shaft. The casing is made either of cast iron or gunmetal, being divided at the centre to admit of fitting the impeller.

The pump, to work efficiently, must not contain any air, as this seriously interferes with its working; therefore they are always fitted with an air cock at the top of the casing, which is connected to a condenser or air pump chamber so that they may be exhausted at starting. When there is no air pump or condenser available from which to obtain the necessary vacuum, a small ejector is fitted on the top of the pump and connected to the steam valve of the driving engine. Then by simply turning on the steam we can easily exhaust the pump of any air it may contain.

For land installations the air and circulating pumps are often cast together in the form of an oblong box, there sometimes being as many as three air pumps and one circulating pump in the same casting. This conduces to rigidity and compactness. Another point noticeable in modern designs is that the electric motor is becoming the favorite method of driving these plants where current is available. In conclusion we think that as far as efficiency is concerned the present day air pump leaves very little room for improvement, as I have to-day had the pleasure of seeing an Edward's double acting air pump working at a vacuum of 29.5 inches of mercury by the mercury gauge, the barometer at the time standing at 29.8 inches.

## SOME CHARACTERISTICS OF CEMENT BRICK.

(Continued from Page 662.)

In the tests, some peculiar phenomena were noticed. The best test on a 3 to 1 brick shows 5,460 lbs. per sq. in. The best on a hard-burned "body" clay brick showed 5,470 lbs. per sq. in. The average on the clay brick was 5,120 lbs., or slightly less than that for the average cement brick at nine months.

Two bricks made at the same time, from the same stock, show varying results. For instance, two bricks (3 to 1) 275 days old; first crack at 155,200 lbs. and ultimate strength 155,200 lbs., first crack at 169,000 lbs. and ultimate strength 174,000 lbs. Compare that with the clay bricks: first crack at 94,000 lbs., and ultimate strength 162,000 lbs.; first crack at 101,000 lbs., and ultimate strength 150,000 lbs. Average results show the first crack to be at 0.974 per cent. of the ultimate strength for 3 to 1 cement brick, 0.96 per cent. for 4 to 1 brick, and 0.943 per cent. for 5 to 1 cement brick; and 0.625 per cent. for clay brick. The lowest percentage shown in any cement brick was 0.876 per cent.

Six kinds of cement brick were made and used: (1) common brick, output 13,500 to 14,000 per day; (2) face brick, 9,400 to 9,800 per day; (3) 2-in. radius brick for inside jambs, 8,400 to 8,800 per day; (4) outside corner brick (face and one end waterproofed), 8,000 to 8,400 per day; (5) headers, with one end faced, for arches and header courses, 9,000 to 9,400 per day; (6) white brick (faced with white cement for interior of the engine room), output the same as for the face brick.

## PROBLEMS IN APPLIED STATICS.

T. R. London, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

Fig. 91 is the Statical Diagram for the forces acting at the point ACE. Constructing the Vector Polygon (Fig. 92) for this set of forces, it is seen that the force CE acts away from the point and the force EA against the point. The member CE is, therefore, in tension, and the abutment reaction EA acts upward as would be expected.

Fig. 94 is the Vector Polygon for the forces acting at the point DBF as represented in the Statical Diagram (Fig. 93). The force BF evidently acts against the point and the force FD acts away from the point. The abutment reaction BF, therefore, acts upward, and the member FD is in tension.

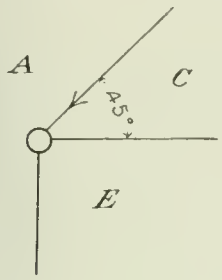



Fig 91.

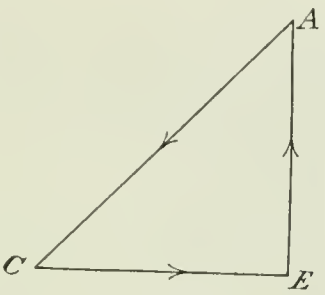



Fig 92

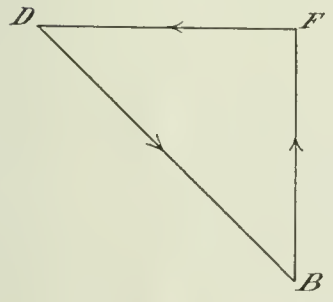



Fig 94.

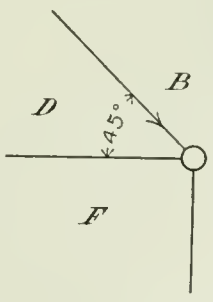



Fig 93

### Stress Diagram.

The construction of the Stress Diagram for the truss (Fig. 82) is as follows: It will be primarily assumed that the reader has found the stress in the member CD by the method previously indicated. The reason for this assumption is that the construction necessary to find the stress in the member CD will not fit in harmoniously with the subsequent construction of the Stress Diagram.

Considering the point ABDC of the truss (Fig. 82), it is seen that the lines AB, DC (dotted line), BD (dotted line), and CA (Fig. 95) form a Vector Polygon for the forces acting at this point. Reconstructing this polygon by the method outlined in the discussion of the forces indicated in Statical Diagram (Fig. 89), a new Vector Polygon, AB, BD, DC, and CA (Fig. 95), is had, and instead of placing sense marks on the lines composing this last polygon, and any polygons to follow, **a heavy line will be used to indicate forces acting against the point, due to members in compression; a light line indicating forces acting away from the point, due to tension members; a double line being used to represent forces due to loads or abutment reactions, whether they act against or away from the point being considered.**

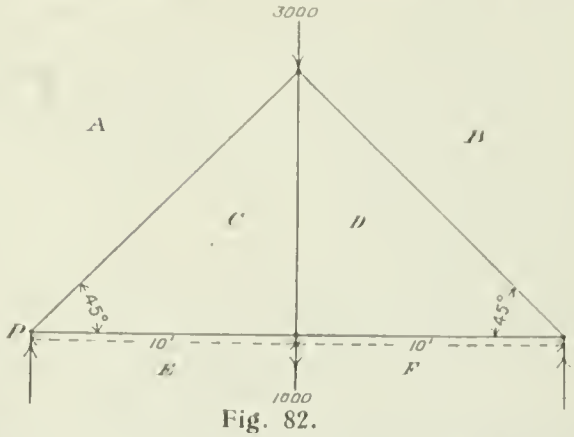



Fig. 82.

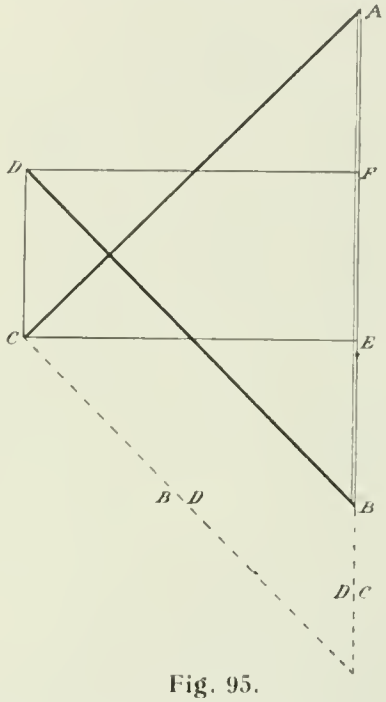



Fig. 95.

Referring to Statical Diagram (Fig. 91) for the point ACE, it is seen that the force AC exerted by the compression member AC acts against the point, and is necessarily equal but opposite to the force exerted by the same member at the point ABDC. It is evident, then, that the heavy line AC (Fig. 95) may represent the force AC (Fig. 91). If, now, a line be drawn from C to represent the direction of the unknown force CE (Fig. 91), and if a double line be drawn from A to represent the direction of the unknown abutment reaction EA, intersecting the last line at E, the lines AC, CE, and EA will form a Vector Polygon for the forces being considered. It is quite evident that the force EA, being a vertical force, the line EA (Fig. 95) representing it will coincide with the line AB.

Considering the forces acting at the point DBF (Statical Diagram, Fig. 93), it is seen that the heavy line DB (Fig. 95) may represent the force DB (Fig. 93). Drawing from B a double line to represent the direction of the unknown abutment reaction BF (this line will, of course, coincide with BA), and from D a line repre-

senting the direction of the unknown force FD, intersecting the double line at F, the Vector Polygon for the forces being considered is completed. This polygon should read DB, BF, and FD. (Compare with Fig. 94).

From a consideration of the point DFEC, it is seen that the lines CD, DF, FE, and EC, already constructed in Fig. 95, form a Vector Polygon for the set of forces acting at this point.

**Simultaneous Use of Equations $\Sigma X = o$ and $\Sigma Y = o$.**

In the work previous to this, it has always been possible to determine the unknown forces of a set, one at a time, by the independent use of either the equations $\Sigma X = o$ or $\Sigma Y = o$. In the case that will be taken up next, and in many other cases, it is only possible to arrive at results by the simultaneous use of the two equations $\Sigma X = o$ and $\Sigma Y = o$, and in such cases certain precautions must be observed.

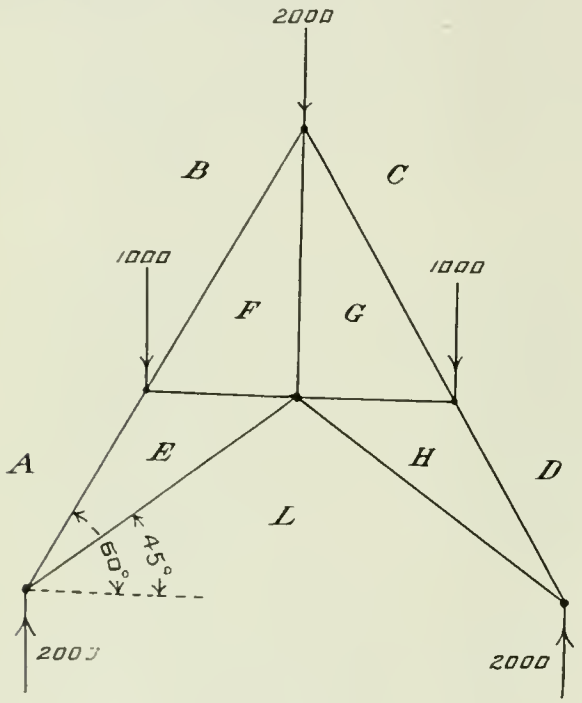



Fig. 96.

The roof truss (Fig. 96) is known as a German Truss. This form of structure is obsolete as far as practice is concerned, but is taken up because it serves very well the purpose of illustrating the point under discussion.

**FRAZIL.**—(Continued from page 666).

At all of the plants above mentioned the racks or screens are kept free of ice by electric motor-driven rakes, and at present none of them is supplied with heat. Mr. John Murphy,* under whose advice the heating schemes were installed, recommends that the racks be submerged or otherwise protected from the atmosphere, and contends that then only a small amount of heat is necessary to keep ice from clinging to the racks. The operators of the plants, however, think that the electro-mechanical rakes afford sufficient protection and do not employ heat at the racks.

The coming winter's experience will add another interesting chapter to the subject of protecting Canadian hydraulic power plants from ice troubles.

* The Canadian Engineer have in pamphlet form Mr. Murphy's article on "Ice Troubles in Hydraulic Power Work."

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## THE PURCHASE OF COAL BY THE B.T.U. METHOD.

By Samuel A. Taylor.*

In these days, when conservation in all things seems to be the watchword of the leaders of our nation, the question of purchasing coal by the British thermal unit method has been attracting the attention of large consumers of fuel.

This method has attained considerable prominence, because a superficial knowledge of the condition under which coal is consumed will bring to the mind of the consumer the question of economy by using a coal containing the highest number of B.t.u. per pound of coal, and he will figure out this economy by the simple rule of proportion.

For illustration, we will assume that the consumer will figure that if he can buy a coal at the mine containing 13,000 B.t.u. for $1.30 per ton, to which he must add the cost of freighting the same to the place of consumption, plus the cost of handling—which we will assume is the same as on a higher B.t.u. coal—it becomes a simple calculation for him to see that his coal is costing him at the rate of one cent for every 100 B.t.u. at the mine; and if he can secure other coal at the same price at the mine at this rate per 100 B.t.u. it is economy for him to pay this rate of one cent per 100 B.t.u. in excess of the 13,000 B.t.u. in the common grades of coal, and, as a rule, he is very willing to do this.

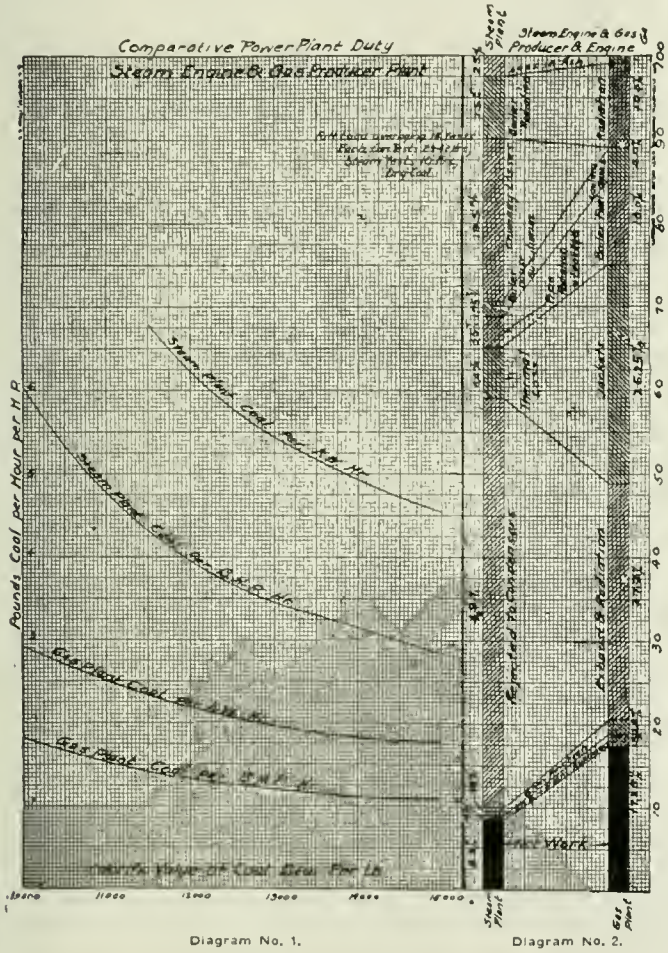
Comparative Power Plant Duty
Steam Engine & Gas Producer Plant
Steam Engine & Gas Producer & Engine
Pounds Coal per Hour per H.P.
Heat Value of Coal Used Per Lb.
Work

Diagram No. 1. Diagram No. 2.

Diagram No. 1 shows comparative power plant duty. Diagram No. 2 shows approximate distribution of losses and comparative thermal efficiency of steam engine and gas producer and engine.

If this were all that is in the question, the matter would be simple, and the consumer who would not take advantage of this condition would be considered, to say the least, very short-sighted.

In order to get at the real significance and consequences of putting this into practical operation generally, a much more comprehensive study of the question must be given.

In order to discuss the subject properly, we should first get clearly in mind the meaning of the term B.t.u. and the method of determination, in order that we can arrive at a logical conclusion as to what would be the best method of practical procedure in any case we might have before us for consideration.

The B.t.u. is defined as being that amount of heat which is necessary to raise one pound of water from the temperature of 32 deg. to 33 deg. Fahrenheit. It is, however, not practised exactly as stated. In some cases it is from 59 to 60 deg., but is usually determined at the temperature of 103 to 104 deg. F., which corresponds to the French practice in the metric system of 40 deg. of the Centigrade scale.

The method of determining heat units now generally practised is by use of the bomb calorimeter, in which is placed a certain quantity of fuel to be tested in an air-tight crucible and burned to complete combustion by the use of oxygen, the crucible being immersed in a known quantity of water at a temperature determined before and after the burning takes place. The change of temperature, the quantity of water and the amount of fuel being determined, it is a mere matter of calculation to ascertain the heat units contained in the fuel tested.

Physicists and chemists are somewhat at variance as to the details of operation of the various calorimeters, as well as the temperature at which the experiments should be conducted, and some other matters pertaining thereto; so that, by this diversity of opinion, there are a number of formulæ given for determining the B.t.u. in any fuel based on chemical analyses of the coal.

The one commonly used by the French is known as the "Dulong" formula, and is as follows:—

$$8080\ C + 34460\ (H - 1/8\ O) + 2250\ S = \text{Calories} \times 1.8 = \text{B.t.u.}$$

Then there is a formula which is used quite extensively, and practised by some of the chemists, known as the "Mahler," as follows:—

$$8140\ C + 34500\ H - 3000\ (O+N) = \text{Calories} \times 1.8 = \text{B.t.u.}$$

Third, a simplified formula of "Mahler," which is:—

$$20050\ C + 67500\ H - 5400 = \text{B.t.u.}$$

For this last formula it is claimed to be accurate for coal, and fairly accurate for wood and oil.

In all of these formulæ C = the carbon present by weight, H the hydrogen present by weight, O the oxygen present by weight, S the sulphur present by weight, and N the nitrogen present by weight; all expressed decimally as to the total weight of the fuel.

In order to show the range of results given by these various methods, I will refer to the report of the United States Geological Survey Coal Testing Plant, which gives a test of Pittsburg coal, designated as Pennsylvania No. 10, in order to show the comparison, the ultimate analysis of which is as follows:—

| | |
|---|---|
| Carbon | 77.14 |
| Hydrogen | 5.21 |
| Oxygen | 8.65 |
| Nitrogen | 1.57 |
| Sulphur | 1.26 |
| Ash | 6.17 |
| B.t.u. | 13,997 |

By taking this same analysis, and figuring the B.t.u. by the Dulong formula, we get 13,832 B.t.u. From the Mahler formula we get 13,986 B.t.u., and from the Mahler simplified formula we get 13,583 B.t.u.

* Paper presented at Goldfield meeting of American Mining Congress.

From the foregoing statements it will be readily ascertained that, in order to avoid misunderstanding after a contract has been consummated and coal is being furnished thereunder, it should be definitely stated how the B.t.u. are to be determined. Possibly the most satisfactory way at present would be by bomb calorimeter.

Another matter pertaining to this determination, which is also a subject of a great deal of controversy, is the question of sampling the coal to be tested. I am decidedly of opinion that the proper place to take these samples is in the mine, in order to get a fair test to the producer of the coal of the entire output of the mine; for, in the last analysis of the matter, the deductions, if any are to be made, must come off the producer, as will be shown later.

The ordinary method of taking small amounts of coal from different positions in the car may or may not represent fairly the coal in the car. Unless a large amount of coal is taken and crushed and mixed before taking sample for test, it is not very likely to be a fair test of the coal, and will always lead to dissatisfaction to one or both of the parties interested.

In addition to the question of taking the sample on the car at destination, unless the coal is shipped in closed cars, the coal will lose some of its volatile hydrocarbons and take up moisture. Especially is this true in the case where transportation consumes a considerable period of time in reaching destination. It has recently been demonstrated by the United States Government that the additional oxygen taken up by coal in transit materially reduces its B.t.u., which is certainly a matter that the producer of the coal should not be taxed for, as it is a matter over which he has absolutely no control. If anyone should be assessed for this, it should logically be the transportation company. This would, of course, lead to such a complicated situation that it would be practically out of the question; and without some equitable way of adjusting all of these questions the whole scheme must fail of the results desired to be obtained.

Another question that is often raised is: Who should be the party to make these tests? It will always be unsatisfactory for the purchaser himself to make the tests, for, by so doing, he will always be subject to criticism, in case of the coal showing up as of lower quality than guaranteed, that the tests were unfair. Therefore, the necessity for some person to make these tests who would be employed jointly by both parties to the contract, or having the tests made by some Government arbitrator, is essential, in order that anything like satisfactory relations may exist between the seller of the coal and the purchaser thereof.

The United States Government has recently made public the result of purchasing coal under its own specifications in Bulletin 378 of the United States Geological Survey. As set forth in this bulletin, the two items which the Government penalizes and premiumizes are ash and B.t.u. It specifies a certain amount to be deducted or added from an agreed upon per cent. of ash, as the coal is found to contain more or less ash by analysis than a fixed standard, at an agreed upon price for each 1 per cent. of difference, and, likewise, an amount to be added or deducted as the B.t.u. are increased or diminished above or under a fixed number of B.t.u. at an agreed upon price per hundred.

The result of some thirty different contracts is published in a table of the above bulletin, a copy of which is given herewith in order that we may be able to compare the results in a practical way as they obtain them by this method of purchasing coal.

| | Contract Basis. | | | | Contract Fulfilment. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tons of 2,240 lbs. | Price per ton. | B.t.u. coal as received. | Ash in dry coal. | Tons delivered | Average B.t.u. in coal as delivered. | Average ash in dry coal, per cent. | Average moisture, per cent. | Cost per ton. | — = Penalty. + = Premium. |
| 1 | 2,250 | $3 31 | 14,200 | 8.00 | 1,791 | 14,130 | 1.84 | 2.18 | $3 29 | — .02 |
| 2 | 350 | 3 41 | 14,200 | 8.00 | 1,318 | 14,190 | 6.43 | 3.40 | 5 19 | — .21 |
| 3 | 1,500 | 5 40 | 14,750 | 6.25 | 862 | 12,543 | 13.40 | 3.82 | 2 29 | — .61 |
| 4 | 1,350 | 2 90 | 13,770 | 4.75 | 6,242 | *11,155 | 11.55 | 12.59 | 2 34 | — .56 |
| 5 | 8,000 | 2 90 | *13,400 | 7.50 | 413 | *11,310 | 11.30 | 11.89 | 2 41 | — .49 |
| 6 | 500 | 2 90 | *13,400 | 7.50 | 2,658 | 14,574 | 5.67 | 2.02 | 2 97 | — .03 |
| 7 | 3,000 | 3 00 | 14,700 | 5.00 | 1,189 | 13,440 | 9.07 | 3.66 | 3 10 | — .20 |
| 8 | 1,400 | 3 30 | 14,000 | 4.36 | 1,416 | 11,458 | 13.82 | 7.97 | 1 81 | — .14 |
| 9 | 1,850 | 1 95 | 12,200 | 11.50 | 1,192 | 12,909 | 10.39 | 4.45 | 3 26 | — .14 |
| 10 | 1,600 | 3 40 | 13,466 | 9.67 | 550 | 11,927 | 9.99 | 8.56 | 4 58 | — .12 |
| 11 | 500 | 4 70 | 12,250 | 8.60 | 981 | 13,916 | 9.36 | 1.34 | 3 73 | — .02 |
| 12 | 1,050 | 3 75 | 14,000 | 8.50 | 2,067 | 14,022 | 7.93 | 2.58 | 3 35 | — .11 |
| 13 | 2,500 | 3 46 | 14,474 | 7.80 | 9,300 | 13,982 | 8.39 | 2.64 | 3 37 | — .08 |
| 14 | 10,000 | 3 45 | 14,315 | 6.80 | 1,323 | 12,709 | 11.91 | 4.21 | 4 89 | + .20 |
| 15 | 1,700 | 4 69 | 12,299 | 13.00 | 1,520 | 13,861 | 9.63 | 1.92 | 3 43 | — .15 |
| 16 | 1,500 | 3 58 | 14,474 | 7.80 | 2,958 | 13,980 | 9.37 | 3.06 | 3 07 | — .11 |
| 17 | 4,500 | 3 18 | 14,474 | 7.80 | 7,479 | 13,898 | 9.34 | 2.36 | 2 85 | — .04 |
| 18 | 1,226 | 2 89 | 14,100 | 8.00 | 374 | 14,490 | 5.54 | 2.59 | 3 06 | + .17 |
| 19 | 300 | 2 89 | 13,700 | 6.00 | 721 | 13,648 | 9.71 | 4.15 | 2 68 | — .21 |
| 20 | 624 | 2 89 | 14,500 | 6.00 | 3,396 | 11,278 | 13.35 | 10.26 | 2 30 | — .25 |
| 21 | 4,700 | 2 55 | 12,500 | 12.00 | 145 | 11,303 | 15.65 | 6.54 | 4 08 | — .62 |
| 22 | 250 | 4 79 | 12,250 | 8.00 | 1,201 | 11,425 | 13.34 | 8.11 | 4 31 | — .39 |
| 23 | 1,200 | 4 70 | 12,250 | 8.00 | 395 | 11,789 | 9.61 | 9.28 | 4 21 | + .09 |
| 24 | 500 | 4 12 | 11,475 | 6.91 | 6,267 | 14,589 | 7.12 | 1.51 | 3 55 | |
| 25 | 7,000 | 3 55 | 14,600 | 6.00 | 1,124 | 14,237 | 6.55 | 3.59 | 3 88 | — .10 |
| 26 | 500 | 3 98 | 14,600 | 6.00 | 276 | 14,371 | 6.79 | 2.65 | 3 97 | — .06 |
| 27 | 350 | 4 03 | 14,600 | 6.00 | 3,050 | 13,493 | 11.63 | 2.38 | 2 69 | — .20 |
| 28 | 3,000 | 2 89 | 14,300 | 8.00 | 20,100 | 14,166 | 7.70 | 2.52 | 3 47 | — .03 |
| 29 | 15,000 | 3 50 | 14,300 | 7.50 | 540 | 13,851 | 9.69 | 2.58 | 3 71 | — .04 |
| 30 | 300 | 3 75 | 14,000 | 10.00 | | | | | | |

1—Baltimore Vintondale, Pa.
2—Baltimore. Vintondale, Pa.
3—Boston, Pocahontas, New River or Georges Creek.
4—Buffalo. Oak Ridge, Hillville, Pa.
5—Chicago. Pawnee-Himrod, Ill.
6—Chicago. Pawnee-Himrod, Ill.
7—Cincinnati. New River Sewell coal.
8—Detroit. Kanawha, Oakland, W. Va.
9—Louisville. St. Charles and Fox Run, Ky.
10—Milwaukee. Youghiogheny screened, Pa.
11—Minneapolis. Ziegler, No. 1, Ill.
12—New Orleans. Pratt City, Ala.
13—New York. Acme, Hawk Run, Pa.
14—New York. Delta, Spangler, Pa.
15—Omaha. Fleming, run-of-mine, Kan.
16—Philadelphia. Acme, Hawk Run, Pa.
17—Philadelphia. Acme, Hawk Run, Pa.
18—Philadelphia. Irvona, run-of-mine, Clearfield, Pa.
19—Philadelphia. Run-of-mine, Clearfield, Pa.
20—Philadelphia. Imperial, run of mine.
21—St. Louis. Staunton lump, Ill.
22—St. Paul. Ziegler No. 1, Ill.
23—St. Paul. Ziegler No. 1, Ill.
24—Toledo. Milton, Jackson lump, O.
25—Washington. Sugar Loaf, Twin Rocks, Pa.
26—Washington. Sugar Loaf, Twin Rocks, Pa.
27—Washington. Sugar Loaf, Twin Rocks, Pa.
28—Washington. Irvona, run-of-mine, Clearfield, Pa.
29—Washington. Georges Creek, run-of-mine, Md.
30—Washington. Orenda, run-of-mine, Somerset, Pa.

From an analysis of the table it will be noted that only in four cases out of the thirty contracts have premiums been paid on the purchase of coal, viz.:—

No. 2 paid a premium of 8 cents per ton.
No. 15 paid a premium of 20 cents per ton.
No. 19 paid a premium of 17 cents per ton.
No. 24 paid a premium of 9 cents per ton.

The others range from a penalty of 2 cents to a maximum of 62 cents in the case of No. 22; and only in one case in the thirty has the price remained equal to the contract price.

From a study of the table on the opposite page it will readily be seen that at least one or more of three things will be the result of this method of purchasing coal should it come into general practice.

1st.—The defeat of the principles of conservation.
2nd.—The increased cost of coal to the consumer.
3rd.—The introduction and installation of new methods of using coal of various grades.

In the first case, that of the conservation of the coal for future generations, which has been strenuously advocated by officials of the Government, as well as by various public-spirited citizens outside of the employ of the Government, will be affected in a directly opposite way to that which has been the desire of the conservationists; for the reason that, if this method of purchasing coal were to become generally practised, only the highest quality of coal could successfully meet the strictures of this competition at a profit to the producer; and the further result that the poorer quality of coal would either remain unmined, or, as in the case of much of the Pittsburg seam of coal, probably one-half of the coal in the vein would have to be wasted. As the same conditions will exist in a number of other seams of coal, the inevitable result would be the wasting of a great quantity of the coal from these seams as at present produced and used, and might, therefore, overbalance, in the end, any benefits which might temporarily be gained by this system.

In the second place, the final cost to the consumer, if this method became general, would mean that the general price of coal would have to be increased, and that the basis of purchase must be that of the poorest grade of coal. The cost to produce this poorer coal, together with a fair margin of profit, must, of necessity, be the basis of calculation, for the reason that the poorer grade of coal cannot be mined unless the above condition is maintained; and, if it should not be mined, the better grade of coal would naturally rise in price, and continue this upward trend until the prices would be equal to the cost of the cheaper grade of coal at such price as the producer thereof would be willing to sell it, which, in the end, would have the effect of maintaining a much increased cost of coal to the consumer over the present method of purchase.

To simplify this, let us put the matter in the form of an equation. Assume, for instance, that the price of coal delivered at some point, say, Cincinnati, would be $3 per ton on whatever specifications might be agreed upon. In the making up to this price of $3 we will place as the first member of the equation the cost to the consumer; we will place as second member the cost of production at the mine, say, 90 cents per ton, plus an average profit of, say, 10 cents per ton, plus a freight rate from the mine to the point of consumption of, say, $1.50 per ton, plus a handling charge through the office, yards, or wherever it may be, of 50 cents per ton. This equation, therefore, as written out, is:—

| Sales price. | Production. | Profit. | Freight. | Handling. |
|---|---|---|---|---|
| $3.00 = | 90 cents + | 10 cents + | $1.50 + | 50 cents. |

This equation is normal, and, so long as all the factors entering into the selling price of coal are maintained, it still remains normal; but let us consider the change resulting from the B.t.u. method of purchase.

Say, the first member of this equation is based on the fact that it will produce a certain number of B.t.u. and a fixed per cent. of ash, a variation in either of which will change the first member of the equation, and it will readily be seen that the changes susceptible of being made in this member, as per Government specifications, could have a very great range in amounts, and, consequently, by a similar number of changes, in the price. Therefore, we must inquire what function in the other members of the equation can be changed in order to offset this change in the first member so as to still maintain the normality of the equation, and, on investigation, we find that the freight rate and the handling charges practically cannot be changed; therefore, these two factors of the second member are eliminated from consideration.

The final cost of production at the mines, if susceptible of any change at all, is so small that it is almost negligible, and, for all practical purposes, may be ignored, although, with the introduction of new factors in the method and costs of production, may be increased.

It must, therefore, remain that any change that can be made must be made from the second function in this second member of the equation, namely, the profit; and, as this profit is fixed at a nominal amount, as soon as the amount of deduction mentioned in the first member of the equation exceeds the amount allowed for this profit it becomes a minus quantity, or a loss to the producer. While it is quite likely that the contract would be drawn sufficiently rigid to hold the producer to the furnishing of the coal, provided he had sufficient capital back of him to carry out the contract or his bondsmen were liable for the amount which would cover his loss, the contract would likely be fulfilled; but, in any event, whether he had the capital or not, if he would lose on this contract it would only be fair to assume that he would not enter into another of the same character without getting a price sufficient to overcome any possibility of loss

by reason of his coal not coming up to the specifications in ash and B.t.u.; for it will be accepted without controversy that no company can or will continue to operate at a loss for any considerable period of time, and that whatever is purchased must be paid for by somebody.

The argument in favor of this method, however, is that it makes the producer much more careful in preparing his coal, and, therefore, being better prepared, it contains less slate and other objectionable material which go to make ash, and he will be more careful to maintain it in good condition. This, from a theoretical viewpoint, is largely true, but at the majority of mines, under present labor conditions, it is almost impossible for the producer to improve much on his production without a very material increase to present cost, which will again increase the first function of our second member of the equation, and consequently require an addition to price in the first member of our equation.

It is, therefore, quite evident that the practical end of this production, so far as ash is concerned, can be an increased cost of production somewhat improved, but the second feature of the specifications, which require a certain fixed number of B.t.u., is largely a chemical question, not one over which either operator nor miner has control, other than to reduce the amount of ash as much as possible.

It must, therefore, be readily seen, in order to continue on this basis of selling coal, that the first member of this equation must be raised sufficiently high to take care of the probable penalties which may be assessed against it by reason of the fact of the coal containing more ash or less B.t.u. than the contract calls for, and still allow the producer to have a fair margin of profit over and above the actual cost of production, and would be accomplished by making the standard for both ash and B.t.u. such as the lowest grade of coal within the competitive district would produce, together with a fair margin of profit for the producer of that coal, which, of course, would mean a much higher price for the better grades of coal. This would probably be only fair to both consumer and producer, but it will take time to have this consummated.

There is, to my mind, no other way out of this: it is inevitable. There must be a normal equation in the business of the country between the producer and the purchaser, although it may take some time to bring it about; to do so may leave some financial wrecks by the business wayside, but it can have no other final solution than this.

In the third place, we are brought face to face with the fact that the present practice of purchasing coal by the B.t.u. method is the beginning or preparation for a course which will, in the end, probably result in real conservation of our fuels, notwithstanding that the present rapid advance of this method of purchasing coal, without apparent attention being given to other functions relating to the consumption thereof, leads the consumer into the path of erroneous economy, which may be restored by returning to the due consideration (and what, to my mind, seems to be the most rational method of economy) of that fuel which will give the greatest results in actual practice by continuing the present methods in use with some modifications, or by adopting some new method of utilization which will, in the end, give to the consumer the same required amount of work for less money, after due allowance is made for additional cost in the necessary preparation to use the cheaper grade of fuel economically.

I refer to a chart, appended hereto, data for which were obtained from the "Westinghouse Diary," showing approximate distribution of losses and comparative thermal efficiency of steam engine and gas producer and engine, in order to more clearly set forth what I have in mind.

From an examination of the chart it will be seen where the loss occurs, and the per cent. of loss at the various stages of application of the heat units in actual practice of a stationary steam boiler and engine plant.

In the initial proceeding, that of the boiler plant, practically 35 per cent. of the total heat is lost. This will at once call attention to the fact, as it exists in many plants, that three to four times more heat is lost than is actually secured by the steam engine, which will range from about 3 or 4 per cent. in locomotives to about 12 to 15 per cent. in triple-expansion stationary engines.

By purchasing coal by the B.t.u. method, an economy of from ¼ to ½ of 1 per cent. of the heat units is sometimes obtained, while, with some care, and, possibly, expenditure, 5 to 12 per cent. of the heating value of the coal would be saved by doing away with some of the waste taking place in the boiler and engine plant, and when this fact is brought to the attention of the consumer it would make him think he had placed the cart before the horse, and himself in the penny-wise and pound-foolish class.

The saving in consumption of fuel in the gaseous state is about 50 per cent. of that required when used in the raw state. It may be interesting in this connection to observe that, for small units of about 50 horse-power, the gas-producer plant alone would require about the same space as the boiler plant for the same power, and would cost about the same as the boiler plant. I believe that in some cases it would be economy to dispose of the present method of generating power and install an entirely new plant.

In this connection it may be interesting to note that the Government Testing Station has conclusively shown that by this method of gasifying fuel a poor grade of coal will produce more power when thus treated than a high grade of fuel used in the raw state. I might also state that there is a method of gasifying fuel and saving some of the by-products without serious diminution of the fuel value, and the by-product thus saved will amount to from $2 to $3 per ton of raw material used. Various methods of achieving economies might be enumerated which, I think, will amount to a very great deal more in actual money value, without raising the price of the fuel, than that secured by purchasing by the B.t.u. method.

In conclusion, therefore, it is my opinion:—

First—That while the B.t.u. method of purchasing coal, so far as the purchaser is concerned, may temporarily prove a good thing, it will, in the end, result in his paying much more for his coal.

Second—That so far as it affects the conservation of fuel, it will prove a failure.

Third—That it is quite possible to so study the method and conditions under which fuel may be used as to effect a very great deal more economy to the purchaser, at the same time not destroying the stability of the business of the producer of coal, which is a condition very much to be desired, as a matter of fact, a necessity, and something which will not obtain should the B.t.u. method of purchasing fuel come into general practice.

Fourth—That where the B.t.u. method is used the agreement should state specifically the following:—

(a) The method of sampling the coal for testing, which is the most important item in connection with this method.

(b) The method of determining the B.t.u., preferably with the bomb calorimeter.

(c) The person who would make the tests, and, in case of dispute, to have an arbitrator, agreeable to all parties in any way interested, named in the contract.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Dec. 1909 | EARNINGS Week of Dec. 1908 | STOCK QUOTATIONS TORONTO Price Dec. 10 '08 | Price Dec. 2 '09 | Price Dec. 9 '09 | Sales Week End'd Dec. 9 | STOCK QUOTATIONS MONTREAL Price Dec. 10 08 | Price Dec. 2 09 | Price Dec. 9 '09 | Week End'g Dec 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,905,000 | 1,548,000 | 180 177½ | 178½ | 181 | 695 | 178¾ 178½ | 178½ 178¾ | 181½ 181¾ | 3105 |
| Canadian Northern Railway | 3,180 | ..... | .... | 321 300 | 217,500 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| *Grand Trunk Railway | 3,366 | 226,000 | 100 | 798,847 | 691,243 | ..... | *1st. pref. 103½, 3rd pref. 50½, ordinary 20½ | | | ..... | | | ..... |
| T. & N. O. | 334 | (Gov. Road) | ..... | 32,279 | 17,117 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 73,527 | 64,305 | ..... | ..... | ..... | ..... | 203½ | 202¼ 212½ | 211 215 | 214¼ 1148 |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,500 | 68,850 | 107½ 107 | 125 124½ | 125½ 125 | 292 | 107⅝ 107½ | 124½ 124 | 126 125⅝ | 1116 |
| Winnipeg Electric | 70 | 6,000 | 100 | .... | ..... | | 166 185 | 185 | 10 | ..... | ..... | ..... | ..... |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto & York Radial Railway.
Windsor, Essex & Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.

## NIAGARA, ST. CATHARINES AND TORONTO RAILWAY

Some of the particulars published in our issue of November 26th, in reference to the above company, were incorrect. Below we give a revised list of the officials and the equipment of the road:—

President, D. B. Hanna, Toronto.
General Manager, E. F. Seixas.
Superintendent, W. R Robertson, St. Catharines, Ont.
Chief Engineer, Walter P. Chapman, Toronto.
Master Mechanic, William Pay, St. Catharines, Ont.
Secretary-treasurer, A. J. Mitchell, Toronto.

**Kind of Road:** Interurban, suburban or street railway.

**Length of Road, in miles:**

Total in single miles, 50.

**Character of Service:**

Car equipment, 36; type, open, closed semi-convertible
Number of motors, 4 per car; power of motors, 50 h.p.
Method of controlling, K and multiple unit.
Method of braking, air.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 80 lbs.

**Power:**

Direct current, D.C.
Voltage of transmission, 11,000 A.C.
Trolley voltage, 625.
Frequency of transmission for A.C., 66 C.
Number of phases, 3.

## PETERBOROUGH RADIAL RAILWAY COMPANY.

President, Mr. Robert Stuart
General Manager, Mr. J. H. Larmonth.
Electrical Engineer, Mr. H. O. Fisk.

**Kind of Road, Street Railway:**

**Length of Road, in miles:**

Total in single miles, 5.1.

**Character of Service:**

Car equipment, 14; type, single truck.
Number of motors, 2; power of motors, 35 horse-power.
Method of controlling, K. 10.
Method of braking, Peacock and ordinary brakes.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 60 lbs.

**Power:**

Direct current, 500 v.

## RAILWAY ACCIDENTS FOR NOVEMBER.

### Eighty-five Killed, Thirty-five Injured.

The record of fatalities on Canadian railways during the month of November was rather extraordinary, no less than eighty-five persons being killed. Two accidents which occurred in the neighborhood of Vancouver were responsible for over fifty per cent. of the killed. A bridge near Sapperton, on the Great Northern Railway, which had been undermined by a sudden flood, collapsed under the weight of a heavy work train carrying a gang of Japanese track laborers who had turned out at midnight to repair the damage, resulting in twenty or thirty deaths, while a tragedy on the electric railway between New Westminster and Vancouver, caused by a runaway freight car, was responsible for fourteen deaths.

Accidents causing neither loss of life nor injury, but resulting in more or less damage to rolling stock and the right of way, occurred in the neighborhood of the following stations: Sudbury, Ont., Campbellton, N.S., Morrisburg, Ont., London, Ont., Hillsboro, N. B., St. Vincent de Paul, Que., Calgary, Alta., Coatsworth, Ont.

**Steam Railways:—**

| Character of Accident. | Passengers. K. | Passengers. I. | Employees. K. | Employees. I. | Others. K | Others. I | Total. K | Total. I. |
|---|---|---|---|---|---|---|---|---|
| Derailment | . | . | 36 | - | .. | .. | 36 | - |
| Trespassing | . | . | 1 | .. | 13 | 1 | 14 | 1 |
| Level crossing | . | . | .. | .. | 8 | - | 8 | 7 |
| Adjusting couplings | . | . | .. | 2 | .. | .. | . | 2 |
| Couplings broke | . | . | .. | 1 | .. | .. | .. | 1 |
| Shunting | . | . | 3 | 1 | . | .. | 3 | 1 |
| Switching | . | . | 1 | 1 | .. | .. | 1 | 1 |
| Fell off cars | . | . | 1 | .. | .. | .. | 1 | . |
| Head-on collision | 2 | . | 1 | 4 | .. | .. | 3 | 4 |
| Broken flange | . | . | . | 2 | .. | .. | .. | 2 |
| Boiler exploded | . | . | 1 | 1 | .. | .. | 1 | 1 |
| Attempt to board moving train | . | 1 | .. | . | .. | .. | .. | 1 |
| Totals, November | 2 | 1 | 44 | 13 | 21 | 8 | 67 | 28 |
| Totals, October | 3 | 4 | 25 | 30 | 11 | 6 | 39 | 40 |
| Totals, September | 0 | 5 | 18 | 15 | 15 | - | 33 | 2- |
| Totals, August | 4 | 5 | 6 | 8 | 22 | 2 | 32 | 15 |

**Electric Railways:—**

| | Total, Killed. | Total, Injured. |
|---|---|---|
| Collision | . | 3 |
| Struck by car | 1 | 3 |
| Coupling broke | 14 | . |
| Fell off | .. | 1 |
| Run over | 3 | .. |
| Totals, August | 3 | 27 |
| Totals, November | 18 | 7 |
| Totals, September | 7 | 32 |
| Totals, October | 2 | 28 |

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received until 20th December, for the construction of Public Baths. Zotique Trudel, architect, 238 St. Andre. A. F. Vincent, secretary-treasurer, Town Hall, St. Louis.

MONTREAL.—Tenders will be received up to Friday, the 17th December, for the construction of an addition to the Superintendent's House and the construction of a stable in the Corporation Yard. L. O. David, City Clerk.

QUEBEC.—Contractors for bridge superstructure are invited to visit the office of the Board of Engineers in the Canadian Express Building, Montreal, after January 3rd, 1910, where information may be had to enable them to prepare bids for the superstructure of a 1,758 feet span bridge 88 feet in width. The contractor is invited to submit alternative designs, which must conform to the conditions laid down in the general specification. L. K. Jones, secretary, Department of Railways and Canals, Ottawa. (Advertised in the Canadian Engineer.)

MONTREAL.—Tenders will be received until Wednesday, the 22nd December, for the supply of one planer, matcher and moulding machine to plane four sides up to 13 or 14 inches, and tongue and groove, also one tenoning and boring machine for wheels. L. O. David, city clerk.

MONTREAL.—Tenders will be received until Wednesday, 22nd December, for 573 new breakwheels and circuit-breaking springs for fire department. L. O. David, city clerk.

**Ontario.**

OTTAWA.—Tenders will be received until Thursday, 30th December, for supply of calcium carbide required by the Department of Marine and Fisheries for one year, estimated at 425 tons. Further particulars may be obtained from the purchasing agent of the Department at Ottawa. G. J. Desbarats, Deputy Minister.

TORONTO.—Tenders for the construction of sewers will be received until Tuesday, December 21st. Specifications may be obtained from Mr. C. H. Rust, city engineer.

TORONTO.—Tenders for counter, screens, book stacks, etc., for branch library on the northwest corner of Gerrard street and Broadview avenue, will be received up to Monday, 10th January. E. S. Caswell, Secretary-treasurer, Toronto Public Library Board.

TORONTO.—The city of Toronto will shortly invite tenders for sixteen tons cast iron manhole covers, sludge valves, penstocks, one hundred and fifty tons of cast iron pipe, twenty-six tons special castings, four 24-inch, two 18-inch, and two 8-inch centrifugal pumps, two 175 h.p., two 125 h.p., two 10 h.p. motors and two 200 h.p. gas engines, garbage destructor, sewage screens and centrifugal dryers. Mr. C. H. Rust is the city engineer.

TORONTO.—Tenders will be received until Monday, December 20th, for alterations and fittings, Drill Hall Toronto. Further particulars obtainable on application to Mr. Thos. Hastings, Clerk of Works, Toronto; Napoleon Tessier, secretary, Department of Public Works, Ottawa. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until December 21st for a supply of 48-inch special castings for the connection between the waterworks tunnel and the new 15 million gallon engine. Mr Joseph Oliver, (Mayor) Chairman Board of Control; Mr. C. H. Rust, City Engineer. (Advertisement in the Canadian Engineer.)

**Manitoba.**

WINNIPEG.—Tenders are invited until Tuesday, 21st December, for annual supply of fuel for Government institutions in the Province of Manitoba. R. Rogers, Minister of Public Works.

WINNIPEG.—Tenders will be received up to Tuesday, January 18, for removing the present superstructure and furnishing and erecting new steel superstructure and floor, complete, for Louise Bridge across the Red River. Plans, specification and forms of tender may be obtained at the office of Colonel Ruttan, the city engineer. M. Peterson, secretary Board of Control.

WINNIPEG.—Sealed tenders, addressed to the Chairman Board of Control, for supply of labor and materials necessary for additions to piers of Louise Bridge, across the Red river, will be received at the office of the undersigned up to 11 a.m., on Thursday, December 30, 1909. Specifications and forms of tender, together with conditions governing tenders as prescribed by by-law, may be obtained at the office of the City Engineer, James Avenue. The lowest or any tender not necessarily accepted. M. Peterson, Secretary. Board of Control Office, Winnipeg, December 8th, 1909.

WINNIPEG.—Tenders will be received up to Friday, December 31st, for the supply of about eighteen thousand posts, for the manufacture and delivery of about forty-two miles of woven wire fence, and for the erection of the fence along the right-of-way of the City's Transmission Line, between the Brokenhead River and the city. M. Peterson, Secretary, Board of Control.

**Saskatchewan.**

SASKATOON.—Tenders will be invited by the Governors of the University of Saskatoon for the construction of a college building, a dormitory and a power house.

**Alberta.**

MEDICINE HAT.—Tenders will be received until Tuesday, January 4th, for clay products plant, including three high-pressure boilers, 120 horse-power Corliss engine, generator and engine, pumps, pans, elevator, pulley, belting, sewer pipe press, structural steel, 4 horse-power gas engine, four side-dump cars, gap lathe, iron planer, forge and blacksmith tools, 500 horse-power heater and fire hose. Address communications to Warren Overpack, 404 N. Des Moines Street, Webster City, Iowa.

**British Columbia.**

PRINCE RUPERT.—Tenders will be received up to Wednesday, the 19th January, 1910 for the construction and completion of a portion of the permanent system of sewerage. Plans, etc., may be seen at the office of Public Works Department, Victoria, B.C., the Government Agent, Mr. James H. Bacon, Harbor Engineer, Prince Rupert, B.C.; the Government Agent, New Westminster, the Provincial Timber Inspector, Vancouver. F. C. Gamble, Public Works Engineer, Victoria, B.C.

VANCOUVER.—Tenders will be received until Wednesday, January 12th, for next year's waterworks supplies, including ten miles of steel and iron pipe, as follows:—Three and a half miles of six-inch, one mile of eight-inch, and two and a half miles of twelve-inch. This pipe is to be three-sixteenths of an inch thick, and to stand a pressure of 300 pounds. 250 tons of four-inch cast iron pipe, are also required. Mr. W. V. Clement is city engineer.

VICTORIA.—The Grand Trunk Pacific Railway is inviting tenders for the construction of large wharves at Victoria, to cost $100,000.

**U. S. A.**

ALBANY, N. Y.—Tenders will be received until Tuesday, December 28th, for improvements to the Erie and Champlain canals. Further particulars on application to F. C. Stevens, superintendent of Public Works, Albany, N. Y., and at Canal office, Spaulding's Exchange, Buffalo, N. Y.

DETROIT, MICH.—Proposals will be received up to Tuesday, December 28th, for furnishing and erecting the structural steel and iron work for Engine Room building of the New Pumping Station. Benj. F. Guiney, Secretary.

PITTSBURG, PA.—Responsible parties can secure opportunities of figuring on 400,000 cubic yards of dirt work, provided they have the proper shovel plant and can give proper references. R. L. McKallip, 2835 Smallman Street.

HOLTON, KANS.—Tenders will be received until January 12th, for the construction of, (a) About 45,000 feet of 8-in. sewer; 64 M.h.; 35 ft. (b) About 14,000 feet of 10-in., 12-in. and 15-in. sewer; 41 M.h. (c) A disposal plant. William C. Bryant, Engineer.

## CONTRACTS AWARDED.

**Nova Scotia.**

HALIFAX.—Tenders for three thousand feet of fire hose were considered at Monday's meeting of the firewards, and the following contracts, for 2½-inch hose, were awarded:—Canadian Rubber Company, of Montreal, 1,000 feet "Keystone" brand at $1; 1,000 feet "Paragon" brand at $1 to the Gutta Percha & Rubber Company, of Toronto; 500 feet of "Para" at $1 to Stairs, Son & Morrow, of Halifax, and 500 feet "Crescent" at $1 to Austen Brothers, of Halifax. The La Franc Company, of Elmira, N.Y., U.S.A., will supply 200 feet of chemical engine hose at 60 cents, while the Dunlop Rubber Company, of Toronto, received an order for a hundred feet at 50 cents and a quantity of suction hose.

SYDNEY.—William Little has been awarded a contract for sewer construction at 23 cents a foot.

**Quebec.**

ARTHABASKA.—For the construction of a steel bridge on the Becancour River, the County of Arthabaska received the following tenders, that of Joseph Gosselin being accepted:—

| | |
|---|---|
| J. Lacoursiere, N. Nolin and J. D. Lachance, Quebec | $21.570 |
| The Laurentian Construction & Engineering Company, Montreal | 20,910 |
| MacKinnon, Holmes & Company, Sherbrooke | 20,225 |
| The Phoenix Bridge & Iron Company, Montreal, P.Q. | 19,925 |
| Pepin & Michaud, Arthabaska | 18,300 |
| The Jenks-Dresser Company, Sarnia, Ont. | 17,360 |
| Joseph Gosselin, Levis, Que. | 16,000 |

MONTREAL.—The Fairbanks-Morse Company were awarded a contract for supplying steam power plant and electrical equipment for the new plant of the Soledan Mining & Milling Company, of Mexico.

MONTREAL.—The town of St. Louis received the following tenders for the construction of a subway under the C.P.R. tracks:—W. Duquette, $80,000; Henault & Hefferman, $120,000; the Clinton Company, $187,467. The contract was not awarded.

**Ontario.**

COBALT.—The Temiskaming & Northern Ontario Railway have awarded a contract for rock work in the station yards here to Canadian Contracts, Ltd., of Toronto.

HAMILTON.—The tender of the London Machine Company for a punching machine for the board of works yard was accepted at $422.50.

HAMILTON.—The Smart-Turner Machine Company of this city have been awarded the following contracts, amongst many others:—Page Hersey Iron Tube Company, Toronto, a side suction centrifugal pump; the Toronto Ferry Company, Toronto, triplex power pump; Shea's new theatre, Toronto, automatic feed pump and receiver; John C. Mundell & Company, Elora, a duplex pump.

LONDON.—The engineers of the Hydro-Electric Commission will report to the Utility Board at their next meeting that they found the lowest tender for the power station equipment was submitted by the Canadian Westinghouse Company, who will probably receive the contract.

NIAGARA FALLS.—The Canadian Contracts, Ltd., has been awarded a contract by the Ontario Hydro-Electric Commission, for the construction of an underground conduit system, whose purpose will be to form a connection between the sub-station of the Hydro-Electric Commission and the distributing station of the Ontario Power Company. The system will carry cables with a capacity of 12,000 volts.

TORONTO.—The Waterous Engine Works Company, of Brantford, Ont., were awarded the contract for two new steam fire engines at $10,500.

TORONTO.—The tender from the Jenks-Dresser Company, of Sarnia, for $1,000. for the supply, erection, and completion of steel floor beams and posts for the new engine-room at the main pumping station was accepted.

**Alberta.**

FRANK.—General Manager Alfred Muller, of the Canadian Consolidated Coal Company, has let the contract for supplying machinery to H. Y. Lloyd. The proposed plant will be the largest in the Crow's Nest Pass.

**British Columbia.**

VICTORIA.—A contract for construction of Lampson Street School at $14,854 was let to Thomas Ashe, Foul Bay Road.

NORTH VANCOUVER.—The following tenders were opened by the district council for a quarry railroad equipment. Mussens, Ltd., $676, and $25 additional for delivery at the quarry. Langley & Williams, $873. Bayfield & Williams $530, and Robert Ward & Company, for wire rope only.

VANCOUVER.—A. Morrison has been given a contract for grading Ash Street, at $41 a chain and 23rd Avenue at $43 by the municipality of Point Grey.

VANCOUVER.—In response to invitations for tenders on materials, supplies, labor, tools, etc., required in the construction of a reinforced concrete dock in North Vancouver, the North Vancouver Ferries Company, whose stock is controlled by the city, received the following:—

| | |
|---|---|
| *Mr. P. Cotton, Vancouver | $28,952 |
| Patterson Timber Company, Vancouver | 35,900 |
| Booker & Campbell, Bellingham, Wash., U.S.A. | 33,815 |
| Engineer's Estimate | 26,796 |

* Accepted.

George S. Hanes, engineer for city and Ferry Company.

**U. S. A.**

NEW YORK (N.Y.)—The contract for placing 1,200 Raymond concrete piles in the foundations of a reinforced concrete shop building to be erected at the Schenectady works of the General Electric Company by the Stone & Webster Engineering Corporation, has been awarded to George W. Van Vranken, Schenectady, representative of the Raymond Concrete Pile Company, of New York and Chicago.

## RAILWAYS—STEAM AND ELECTRIC

**New Brunswick**

ST. JOHN.—It is stated by Mr. C. O. Foss, superintending engineer of the National Transcontinental in New Brunswick, that ninety per cent. of the grading in that province is now completed. The line through New Brunswick is not very extensive, although the work is heavy and expensive. During the past summer 140 miles of track have been laid, nearly half of the entire section. With the large amount of grading done it is expected that the rest of the track laying will be finished early next summer.

**Quebec.**

HULL.—The Gatineau and Ungava Railway, with a capital stock of two million dollars, will apply to Parliament for power to construct and operate a line from a point on the Transcontinental Railway in Quebec to Leaf Lake, on Ungava Bay, about 800 miles.

QUEBEC.—The Northern Quebec Colonization Railway Company, want power to build a railway from Tadousac, Que., to Hannah Bay, Ontario, with a branch line. Smith & Johnston, Ottawa, Ont., solicitors.

MONTREAL.—It is reported this week that the C.P.R. is not considering any extensive introduction of electric traction on its present system.

**Ontario.**

BRANTFORD.—J. S. Clark and H. C. Zwetsch of Buffalo, are applying to the city council for a franchise in connection with a railway from here to Port Dover.

DESERONTO.—The Bay of Quinte Railway Company, will apply to Parliament for permission to construct a branch 15 miles long from Bridgewater, Ontario to Actinolite Mines, Ontario.

OTTAWA.—The Grand Trunk Pacific Branch Lines Company will apply for permission to build numerous branches in the West and to issue bonds to the extent of $30,000 a mile.

OTTAWA.—The following notices appear in The Canada Gazette for Dec. 11th:—

Western Alberta Railway Company will apply for extension of time for commencing and completing its line.

The Ottawa, Rideau Valley and Brockville Railway, will apply for power to build a railway from Ottawa, to Brockville, Ontario.

Western Canada Power Company, Limited, want to enlarge the scope of their charter, so as to build and operate railways, telegraph and telephone lines. Code & Burritt are their Ottawa agents.

Manitoulin & North Shore Railway want extension of time for completing their Sudbury-Little Current branch and for commencing construction of other branches.

The Toronto Central Terminal Company apply for power to construct and maintain passenger and freight stations and other terminal facilities.

The Hudson Bay and Northwestern Railway will probably amalgamate with the Manitoba & Keewatin Railway.

The Ontario & Ottawa Railway apply for power to build and operate a line from Lake Couchiching to the Township of Snowden to Renfrew, to Hull, to Ottawa.

Hamilton, Waterloo and Guelph Railway will apply for permission to build an extension to Toronto.

TORONTO.—The Canadian Northern Railway will probably construct a spur line along the east bank of the Don into the Ashbridge's Bay district.

TORONTO.—The Grand Trunk Railway have been ordered to build a viaduct at Sunnyside.

**Saskatchewan**

REGINA.—The Saskatchewan Central Railway will apply for permission to build and operate a line through Battleford to Edmonton, with five branches. Smith & Johnston, of Ottawa, Ontario, are solicitors for the railway.

YORKTON.—A locating party of the Grand Trunk Pacific, under the charge of Engineer Greaves, has started to locate a line from Yorkton north to cross the Canadian Northern main line at Canora or Tiny and thence to the Hudson Bay. The line will be commenced in the spring and 42 miles built next summer.

OTTAWA.—Mr. M. J. Butler, deputy Minister of Railways, reported on Monday at some length in connection with the Hudson Bay Railway. Two routes were surveyed. Fort Churchill route of 477 miles would cost, including terminal facilities, $19,108,672; the Nelson route, 410 miles, is estimated to cost, with similar facilities, $16,426,340. The latter is favored. The line is not only 67 miles shorter, but Nelson has a better harbor, while the country through which the line would run is better. A fair proportion of it is available for settlement, whereas on the Churchill route there is no such probability beyond Split Lake. The distance from Liverpool to Port Nelson is 3,200 miles, as against 3,007 from Montreal to Liverpool. The grades are 21 feet to the mile. The Deputy Minister has altered the surveyors' estimates so as to provide for an 80-pound rail instead of 60 pounds.

**Manitoba.**

WINNIPEG.—Construction contracts will be let in March by the Alberta and Great Waterways Railway officials, who expect to have the line in operation to a point 150 miles to the north of Edmonton by the middle of next summer. The remaining 200 miles of the line to Fort McMurray is also expected to be completed by the fall of 1911.

**British Columbia.**

VANCOUVER.—In addition to the Canadian Northern and Kettle River Railway Bills which will be among the first to be considered at the session of the Legislature which opens on January 20th, are many other schemes for new railways in this Province. Last week's "Gazette" contains notices of nine railway bills, seven of which are for new lines. Messrs. Abbott & Hart-McHarg, of this city, are applying for the incorporation of a company to build and operate a railway from Vancouver to New Westminster. A bill is also promised for the revival of the Vancouver & Nicola Valley Railway Company charter of 1908, and another to extend the time for the commencement of operations on the enterprise of the Graham Island Railway Company. Barnard & Robertson have charge of a bill for a rival Graham Island project. Frank Higgins has the interests of another Graham Island road; Taylor, Hulme & Innes are looking after the Robson Bight & West Vancouver Island Railway Bill; and Wilson & Bloomfield the projected road from Menzies Bay to the junction of the Salmon and Memekay rivers.

NELSON.—The portion of the V. V. & E. between Keremeo and Hedley and from Hedley to Princeton, a distance of about 42 miles, which has been under construction for two years, has been accepted by the Government Inspector of Railways, Mr. H. A. K. Drury, and has now passed from the construction department of the Great Northern Railway to the operating department. Chief Engineer J. H. Kennedy is transferring his headquarters to Abbotsford, and is leaving Mr. H. M. Hale to take charge of construction westward from Princeton. Mr. Hale is moving from Hedley to Princeton.

VANCOUVER.—Plans for building a subway between the inlet front and the False Creek railway yards have been marked out by the local engineering staff of the C.P.R.

## SEWAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—Messrs. Quinlan & Robertson have commenced the enlargement of the old conduit.

**Ontario.**

GUELPH.—Contractor Conn, who constructed the new waterworks pipe line, is suing the water commissioners for extras amounting to $9,083.48, claiming that work which had to be done over again to stop leaks in the conduit was not called for in the contract.

ORILLIA.—The Water Committee have recommended extensions of water mains. The acceptance of the Canada Foundry Company's tender referred to on page 606 of our issue for November 26th, was confirmed.

**Saskatchewan.**

SASKATOON.—Sewer and water extensions for 1910 are estimated to cost $200,000. Mr. George S. Clark is city engineer.

**British Columbia**

NEW WESTMINSTER. — The Vancouver Power Company have been granted a patent for a tract of land comprising eighteen thousand acres surrounding Coquitlam Lake and, according to the latest issue of the Canada Gazette, they are prepared to enter into an agreement to supply this city with water.

VANCOUVER.—Waterworks superintendent Maddison reported that it would cost $8,000 to repair the damage done to the civic water system by recent floods.

VICTORIA.—Assistant City Engineer Bryson submitted his preliminary report on the Sooke Lake water scheme at a recent council meeting. He estimated that it would cost $1,500,000 to construct the necessary dam, tunnel and pipe line, and recommended a more detailed survey in the spring.

## LIGHT, HEAT, AND POWER

**Ontario**

LONDON.—There is a movement on foot to sell the plant of the London Electric Company to the city, to be used as a reserve steam plant for Niagara power.

OTTAWA.—A by-law to give the Metropolitan Company a 25-year franchise, for heat and power only, conditional on the company being in a position to deliver 1,000 horsepower in three years will be submitted to the ratepayers at the January elections.

PETERBOROUGH.—On January 3rd, the ratepayers will vote on a by-law drafted to grant the Peterborough Light & Power Company the right to erect poles and supply power for thirty years.

PORT ARTHUR.—The ratepayers of the city are to have an opportunity of declaring their opinion on the respective propositions of the Ontario Hydro-electric Commission and the Ontario & Michigan Power Company at the municipal elections in January.

TORONTO.—The St. Catharines Hydraulic Company are suing the Dominion government for unstated damages in connection with the cancellation of their lease of the water power privileges of the old Welland Canal. Mr. Justice Cassels in the Exchequer Court, reserved judgment.

**British Columbia.**

VANCOUVER.—A new unit which will mean an increase of 10,500 horse-power for the British Columbia Electric Railway, has just been installed at Lake Buntzen, and is now in partial operation. The final test of the new machnery, the installation of which was completed last week, has not yet been made as the governors are not yet placed in position, but it has already carried over 8,000 horse-power with ease.

This additional power unit brings the total number up to five, operating on four transmission lines. The machinery of the new unit includes an electrical generator, made by the Dick Kerr Company, of Preston, England, and a water wheel, the largest of its kind ever made, designed by the Doble Company, of San Francisco, and manufactured by the John McDougall Caledonian Ironworks, of Montreal, Que. From the entrance in the dam, a stave pipe line seven feet diameter runs to the crest of the hill, and from there a steel pipe of about the same diametrical dimensions takes the water to the new wheel in the power house. Work has been proceeding on this addition all summer.

## FINANCING PUBLIC WORKS.

The following municipalities recently sold debentures:—
Point Grey, B. C., $28,000.
Kipling, Sask., $14,000, schools.
Ottawa, Ont., $160,000, schools.
Winchester, Ont., $12,249, cement sidewalks.
Lucknow, Ont., $3,500, civic buildings.

**Ontario.**

BELLEVILLE.—By-laws for a bridge over the River Moira and to grant permission to the Seymour Power & Electric Company, to erect poles and string wires on certain county roads, have passed second reading in the Hastings County council.

PENETANGUISHENE. This municipality will apply to the Legislature for permission to issue debentures amounting to $24,220 for sewer extensions now under way, for completed works and for bonuses to the North Simcoe Railway and several factories.

NEWMARKET.—Debentures for cement walks, bridges, etc., amounting to $20,000, are offered for sale by J. E. Hughes, town clerk.

WATERLOO.—The ratepayers will vote on the following by-laws:—$3,000, gravel pit; $8,000, new market building. Mr. F. S. Kumpf, town clerk.

SARNIA.—A water main by-law is at present before the council.

OTTAWA.—The ratepayers will vote on a $45,000 garbage by-law.

AMHERSTBURG.—The council are considering a $20,000 public school by-law.

PETERBOROUGH. — The ratepayers will vote on a $19,000 isolation hospital by-law.

ST. THOMAS.—The ratepayers will vote on a $25,000 street railway extension by-law.

WELLAND.—The ratepayers will vote on a $13,500 by-law to meet the Methodist Church debt. A new paving by-law is before the council.

NEW LISKEARD.—The ratepayers will vote on the following by-laws; $28,000 for macadamizing streets, and $2,500 for the purchase of fire apparatus.

**Manitoba**

WINNIPEG.—The following by-laws carried: $150,000 for underground conduits for power wires, $50,000 for municipal baths. The by-law for $50,000 for a civic art gallery was defeated.

CARBERRY.—By-laws have been passed to issue $1,561.75 5 per cent. 20-year, and $1,418.75 5 per cent. 20-year local improvement debentures. Geo. Balfour is town treasurer.

GRANDVIEW.—Sewer debentures amounting to $3,000 are offered for sale by William Dickie, secretary, of this town.

**Saskatchewan**

MAIDSTONE.—L. L. Courtice, secretary-treasurer, offers for sale, $2,000 permanent improvement debentures.

**Alberta**

CAMROSE.—Applications will be received up to January 1st, for $6,000 debentures. O. B. Olson, secretary-treasurer.

LETHBRIDGE.—The Parks by-law carried by a large majority, while the street railway and gas franchise by-laws were defeated.

**British Columbia**

POINT GREY.—The ratepayers will vote on a $250,000 street improvement by-law.

VICTORIA.—The ratepayers will vote at the forthcoming election on a $52,000 cemetery extension by-law.

## MISCELLANEOUS.

**Quebec.**

MONTREAL. The Road Committee has made a list of requisitions to meet next year's administrative expenses, amounting to $2,030,284, including:

| | |
|---|---|
| For macadam | $930,333.00 |
| Wooden sidewalks | 179,310.40 |
| Repairs to pavements | 262,050.00 |
| Repairs to sidewalks | 176,489.25 |
| Crossings | 43,714.20 |
| Curbstone | 15,924.20 |
| Gullies | 52,075.00 |

QUEBEC. Preliminary work on the reconstruction of the Quebec Bridge was commenced on Wednesday, December 8th.

**Ontario.**

NORTH BAY.—The town clerk has been authorized to write for prices and particulars of snow ploughs.

OTTAWA.—Hon. G. P. Graham recently stated that the contract for the sub-structure of the new Quebec Bridge had been awarded to M. P. Davis. The contract calls for two pneumatic caissons, two abutments, two anchor piers and one intermediate pier, at a total cost of $2,448,475. The cost of the masonry work in the two pneumatic caissons will be $2,800,000, and these will be required whatever type of superstructure is decided upon. Pending such decision, it was not considered wise to give an estimate of the cost of the superstructure. The total cost to date to the Government of the bridge has been $6,905,852, which includes subsidies to the amount of $374,353.

**Manitoba.**

WINNIPEG.—At a recent meeting of the Board of Control, Mr. W. F. Fallman, city street commissioner, recommended the use of oil for street sprinkling.

WINNIPEG.—Col. Ruttan, city engineer, has prepared particulars of the proposed quay wall along the Red River. The area would be approximately ninety square yards and the bulk thirty cubic y ards per lineal foot. Including concrete, excavation and foundation work, the cost would probably be $400 per lineal foot, say, $2,000,000 per mile. The first thing necessary would be to make a survey, which would give the necessary definite information by boring, etc., and would cost from $3,000 to $4,000 per mile.

**British Columbia.**

VANCOUVER.—The Dominion Railway Commission have granted this city permission to erect a bridge on the C.P.R. tracks at Carrall Street.

VICTORIA.—Plans are said to be completed for a forty million dollar steel industry on the coast. The syndicate, which is known as the Western Steel Corporation, recently purchased large iron deposits on Vancouver Island. Herbert E. Law, of San Francisco, and James A. Moore, Seattle, are interested.

VICTORIA.—Mr. Bayfield, engineer of the Public Works Department, who was previously connected with the Montreal Harbor Works, has outlined plans for a new steel steamer for use as a dredge tender. The department is also considering the purchase, at a cost of $350,000, an elevator dredge for use in improving the First Narrows at Vancouver, for which surveys and plans have been made. One and a half million yards of material will be taken away.

## PERSONAL NOTES.

MR. HUGH C. BAKER, manager of the Bell Telephone Company in Hamilton, Ont., one of the fathers of telephony in Canada, and a builder of the original Hamilton Street Railway, has resigned.

MR. THOMAS LEOPOLD WILLSON of Ottawa, Ontario, receives the first award of the McCharles prize, which will be given from time to time, like the Nobel prizes in a small way, to any Canadian who invents or discovers any new and improved process for the treatment of Canadian ores and minerals, or for any important discovery that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light. Mr. Willson was born in Princeton, Oxford Co., Ontario, and is the inventor of the Willson Acetylene Flare Light, manufactured by the International Marine Signal Company, of Ottawa.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8783—November 30—At St. Antoine Street, Tetraultville, P.Q.; across the C.P.R.

8784—November 30—At public crossing one-quarter mile east of Shaw Station, Ont., and the C.P.R. at public crossing 400 yards west of St. Cuthbert Station, P.Q.

8785 to 8793 Inc.—November 22—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the tracks of the C.P.R. at three points; the C.N.R. at five points; and the G.T.P. Railway at one point in the Province of Manitoba.

8794 to 8798 Inc.—December 1—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its telephone wires across the tracks of the G.T.P. Railway at two points; C.P.R. at two points, and the C.N.R. at one point.

8799 December 1—Granting leave to the Saskatchewan Government to erect, place, and maintain its wires across the track of the C.N.R. at Hague, Sask.

8800—November 30—Directing the C.P.R. to reconstruct the culvert under its tracks at mileage 3.3 Sudbury Section, to carry off the water at Lily Lake, Township of Humphrey, Ont.

8801 December 1—Amending Order No. 7746, dated August 5th, 1909, approving location of C.N.R. from Tp. 15, R. 17, west of the 6th Mer. to Sec 11, Tp. 14, R. 17, west of the 6th Mer., mileage 0 to 5, B.C., by changing the reference to Range 17 in said Order to read "Range 27."

8802—November 29—Authorizing the C.P.R. to open for the carriage of traffic that portion of the second track of its line of railway from mileage 59.4 to mileage 59.6, on its Fort William Section.

8803 November 18—Authorizing the C.N.Q. Railway to construct, maintain, and operate a branch line of railway, or spur from near St. Marc's Junction, through the parishes of St. Marc, Grodines, and St. Albans, County Portneuf, P.Q.

8804 December 1—Approving stress sheets of the C.N.R. Company's Lac Ouareau-Rawdon Extension.

8805—December 1—Granting leave to the C.N.O. Railway to construct its line of railway across six highways in Township of Whitechurch, County York, Ont.

8806—November 30—Extending until June 1st, 1910, the time within which the Bell Telephone Company may file with the Board tariffs of tolls of telephone tolls.

8807 November 30—Extending until June 1st, 1910, the time within which the North American Telephone Company may file with the Board tariffs of tolls of telephone tolls.

8808—November 30—Certifying that amended plan of the right-of-way of the C.N.R. as constructed across the S.E. ¼ of Sec. 24, Tp. 43, R. 4, west of the 3rd Meridian, north 28 miles from Dalemy, has been accepted.

8809—November 27—Dismissing application of the city of Edmonton, Alta., to provide that the G.T.P. Railway and the C.N.R. each install and maintain its own diamond crossing, in the city of Edmonton, Alta.

8810—November 27—Dismissing application of the city of Edmonton, Alta., to provide that the G.T.P. Railway and the C.N.R. each install and maintain its own diamond crossing, and that street barriers or gates, together with home signals, to be operated by a watchman, in said city.

8811 November 30—Authorizing the G.T.R. to construct, maintain, and operate branch line of railway, or siding, in the city of Hamilton, Ont., to and into the premises of the Otis-Fensom Elevator Company, Limited.

8812—November 30—Authorizing the C.P.R. to construct, maintain, and operate a siding to and into the premises of the Noxon Company, at Ingersoll, Ont.

8813 November 30—Directing that the G.T.P. Railway construct highway crossing and road diversion between Secs. 25 and 26, Tp. 35, R. 12, west of the 3rd Meridian, District Saskatoon, Sask., in accordance with and subject to the General Regulation of the Board Affecting Highway Crossings.

8814—November 29—Authorizing the C.P.R. to construct, maintain, and operate industrial spur in Lots 15 and 16, R. 7, Tp. of Aylwin, P.Q.

8815 November 30—Dismissing application of the Townships of Tilbury East and Raleigh, for construction of bridge over Jeannette's Creek and Baptiste Creek by the G.T.R. Company on its Southern Division.

8816 December 3—Authorizing the C.N.O. Railway to open for the carriage of traffic that portion of its line of railway, Ottawa-Hawkesbury Division from Rockland to Hurdman's Bridge, near Gladstone Avenue, Ottawa, Ont.

8817 December 3—Approving by-law of the C.N.O. Railway authorizing D. B. Hanna, Guy Tombs, and W. H. Jordan, each, or any of them to prepare and issue tariffs of tolls to be charged by the C.N.O. Railway between and including Hawkesbury and Ottawa, Ont.

8818 December 3—Approving Standard Passenger Tariff C.R.C. No. 153, providing for maximum passenger rate of three cents per mile between all stations on the C.N.Q. Railway and Ottawa Section of the C.N.O. Railway.

## NEW INCORPORATIONS.

Alex. Bremner, Limited, Montreal, Quebec, $200,000; to manufacture and sell cement, drain pipes, lime, plaster, bricks and to deal generally in builders and contractors' supplies.

The National Engineering Company, Limited, Montreal, Quebec, $20,000; mechancial and electrical engineers. Richard T. Heneker, K.C., of Montreal, is a director.

The General Land & Industrial Company, Limited, $2,000,000. Toronto, Ontario; lumber merchants. Jas. S. Lovell, accountant, is interested.

## NEW CRAB DREDGE.

A powerful self-propelling grab dredge has just been completed to the order of the Egyptian Government for the Upper Nile. This is the third dredge which the Soudan Irrigation Department designed for the work of rectification of the Upper Nile, upon which it is engaged and by means of which the potentiality of the river for irrigation purposes will be greatly increased. The first dredge is of the dipper type for embanking purposes and is already in service. The second is of the hydraulic type and is now being erected at Khartoum, while the third dredge is intended to deal with the "sudd" and will be provided with appliances for cutting the sudd as well as removing it. This vessel is built in the form of a light draft river steamer, 160 feet long by 32 foot beam and 2 feet 9 inches draft, and was built by Wm. Simons & Company, Limited, Renfrew, Scotland. The three dredges have been built to the designs and specifications of Mr. A. W. Robinson, M. Can. Soc. C.E., of Montreal, Consulting Engineer to the Soudan Irrigation Department.

## MARKET CONDITIONS.

Montreal, December 16th, 1909.

The steel trade in the United States is now occupied in laying the foundation for prices of finished material in 1910. Notification has been given of an advance of 50c. per ton in the price of Lake Superior ore for next season, beginning with May.

Already there has been an advance in ore prices in other parts of the United States and abroad. The situation largely depends, however, upon the future of coke. Already furnaces are trying to get $2.80, and it is said that some sales have taken place at that figure for the first half of 1910. Railways have not been conspicuous as buyers during the present month but it is expected that they will place heavy orders during the coming two or three months. There is business in sight for structural material, outside the railways, involving a heavy tonnage. This includes the Quebec Bridge, for which about 60,000 tons will be required, this being one of the largest structures now before the trade. Sheets, tinplates and other iron products, continue in heavy demand, but other classes of material are not being ordered in as large volume as during November. This was only to be expected, as the rate of specifications during October and November was too large to continue. The trade, generally, anticipates higher prices, not only on pig-iron but on finished material of all kinds, for 1910 delivery, especially for such as will require to be made from orders based on last year's costs. At the moment, trade is a little quiet and will probably continue so for some weeks into the new year.

In England, conditions throughout the trade do not show any improvement and, as a matter of fact, little hope can be held out for an improvement during the remainder of this year or for some time to come. The political situation is undoubtedly affecting trade prejudicely and, until this is cleared up, material resumption of activity is unlikely to take place. Prices on pig are being fairly well maintained, especially for steel making grades. Foundry irons are a little weaker. The situation in Scotland is much better than in England, local conditions being more satisfactory. Germao and Belgian conditions show some improvemeot and prices evince an upward tendency. All classes of products from pig-iron are held at bigher figures thao for some time past. This condition will, no douht, be reflected later on in the English markets, especially if American conditions continue to improve. Meantime, however, local conditions in Great Britain are not satisfactory, and stocks of pig-iron are accumulating.

In Canada, the situation is entirely satisfactory. So far as pig-iron is concerned, conditions are becoming more strained than ever. Another furnace is now out of the market, so far as supplying new business is concerned, the reference being to the Midland furnace, its output being sold up till the end of October next. Even the output of the large new furnace, which is expected to go into blast about the beginning of March next, is included in the above statement. When it is remembered that the Nova Scotia Steel and the Dominion Iron companies are both out of the general market, their own output being required for their own steel plants, and that the Algoma plant is in a similar positioo and in fact is also a buyer, it will be seen that there is little Canadian pig-iron for sale. The Algoma plant, however, has made its purchases for many months to come, it is said. Demand for all classes of iron is on the increase and foreign iron will have to be largely drawn upon in order to supply requirements.

Dealers in all sorts of finished and semi-finished material, including plates, sheets, iron and steel bars, pipe and structural steel, report a very dull demand for their various lines. Some mooths and even weeks ago they looked forward confidently to a more active trade and to a stiffening of prices but, up to the present, neither has made its appearance. They have now given up looking for any improvement for the remainder of this year and will be well enough satisfied if it comes along within a reasonable time after the beginning of 1910. That an improvement is coming they confidently predict. Meantime, the market continues as follows:—

**Antimony.**—The market is steady at 8 to 8½c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¼-base; tire steel, $1.00 for 1 x ¼-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch)

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for

(Continued on page 686.)

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THE ECONOMICS OF RAILROAD CONSTRUCTION. By Walter Loring Webb, C.E. Large 12mo, viii + 330 pages, 34 figures. Cloth, $2.50. Contents.—Introduction. Part I.—Financial and Legal Elements of the Problem. Railroad Statistics; The Organization of Railroads; Capitalization; The Valuation of Railway Property; Estimation of Volume of Traffic. Part II.—Operating Elements of the Problem; Operating Expenses; Motive Power; Economics of Car Construction; Track Economics; Train Resistance; Momentum Grades. Part III.—Physical Elements of the Problem. Distance; Curvature; Minor Grades; Ruling Grades; Pusher Grades; Balancing Grades for Unequal Traffic. Index

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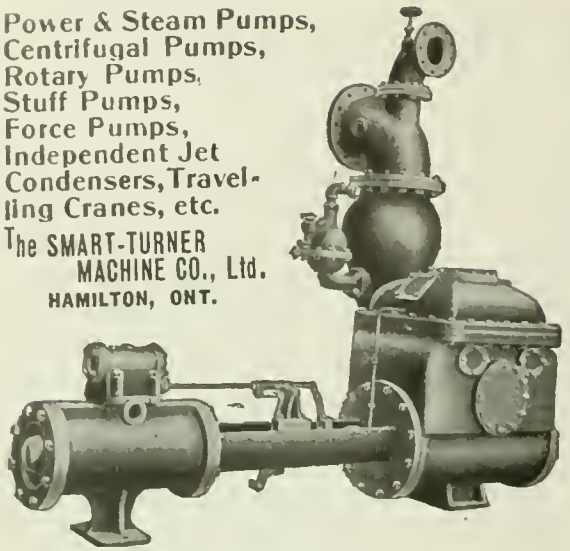

"DESERONTO"
Charcoal Pig Iron
A. C. LESLIE & CO.
LIMITED
MONTREAL

(Continued from page 684.)

each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, ex-store, Montreal, prompt delivery; No. 1 Summerlee, $21.50 to $22 per ton; selected Summerlee, $21 to $21.50; soft Summerlee, $20.50 to $21; Clarence, $19.50 to $20; Carron, No. 1, $21.50 to $22, and Carron special, $21 to $21.50.

**Laths.**—See Lumber etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c freight rate to Montreal Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.15 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being ½-inch, $5.50 with 63 per cent. off for black, and 48 per cent off for galvanized; ¾-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; 1-inch, $8.50, with 60 per cent. off for black, and 49 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black and 62½ per cent. off for galvanized; 1¼-inch, $11.50; 1½-inch, $13.50; 1¾-inch, $22.50; 2-inch, $27; 2½-inch, $36; 3-inch, $57.50; 3½-inch $75.50; 4-inch, $95; 4½-inch, $108.

**Plates and Sheets.—Steel.**—The market is steady. Quotations are: $2.20 for 3-16" $2.10 for ¼, and $2.10 for ¼ and thicker; 12-gauge being $2.30, 14-gauge, $2.35 and 16-gauge, $2.40.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30 rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are firmer at $2.45 per 100 pounds, base of 5⅝ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32½ to 33c.

**Zinc.**—The tone is steady, at 6 to 6¼c.

### CAMP SUPPLIES.

**Beans.**—Prime pea beans, $1.85 per bushel.

**Butter.**—September and October creamery, 26c.; dairy, 22 to 23c.

**Canned Goods.**—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 75 to 80c.; tomatoes, 82½ to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.30; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65.

**Cheese.**—Late makes, 11¾ to 11¾c.; finest makes, ½c. more.

**Coffee.**—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c.

**Dried Fruits.**—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6c.; California, seeded, 7½ to 9c.; Sultana, 8 to 10c. Evaporated apples, prime, 9¼ to 9¾c.

**Eggs.**—No. 1 candled, 26c.; selects, 29 to 30c.; new laid, 35c.

**Flour.**—Manitoba, 1st patents, $5.70 per barrel; 2nd patents, $5.20; strong bakers, $5.

**Molasses and Syrup.**—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 50c.; Porto Rico, 40 to 45c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case.

**Potatoes.**—Per 90 lbs., good quality, 50 to 60c.

**Rice and Tapioca.** Rice, grade B., in 100-lb. bags, $2.95 to $3; C.C., $2.90. Tapioca, medium pearl, 4½ to 4¾c.

**Rolled Oats.**—Oatmeal, $2.45 per bag; rolled oats, $2.20, bags.

**Tea.**—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, greens, 25 to 50c.; low-grades, down to 15c.

**Provisions.**—Salt Pork.—$30 to $32 per bbl.; beef, $15 per bbl.; smoked hams and bacon, 15 to 18c. per lb.; lard, 17c. for pure and 12c. for compound.

**Fish.**—Salted.—Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to $1.25.

* * * *

Toronto, December 16th, 1909.

Ice and snow are lessening the activity of building in both city and country, and for the same reason the movement of many materials for exterior use has declined. Pitch and tar, roofing felt and paper, sewer pipe, and bricks are less active except for repairing purposes, but structural steel, iron pipe, rails and sheets, continue in fair request, and lumber is still moving. Pig-iron shows good activity and holders are firm as to price, the like may be said of boiler plates and tubes. In fact the metals trades, shelf goods included, are more active than is usual at this time of the year.

It is not easy to obtain at this point a clean-cut quotation for cement. The close of navigation makes it hopeless to expect as low prices as have prevailed for recent months, while it is too early to obtain quotations for next spring. Apparently the managers of the Canada Cement Company have not resolved upon any serious or immediate advance, while those mills outside the combine are in no hurry to quote prices.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

**Antimony.**—Demand active and price higher at $9.25 per 100 lbs.

**Axes.**—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9

**Bar Iron.**—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

**Boiler Plates.**—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, DECEMBER 24th, 1909. No. 25



## The Canadian Engineer

ESTABLISHED 1893.

**Issued Weekly in the interests of the**

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**Editor**—E. A. James, B.A.Sc.
**Business Manager**—James J. Salmond

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TORONTO, CANADA, DECEMBER 24, 1909.

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## ENGINEERING DEPARTMENT, QUEEN'S.

Thirteen may be an unlucky number, but the thirteenth annual dinner at the School of Mines was no unlucky function. Queen's Engineering Department know how to entertain and how to properly mix good-fellowship and education.

Queen's University has a total enrolment of fifteen hundred and seventeen, an increase of one hundred and sixty-six over the registration of the previous year.

In the department of engineering the registration for 1909-10 is three hundred and ten, an increase of twenty over the 1908-9 enrolment. The work this department is doing for the university and for the engineering profession has for some time been recognized. The world of affairs and business must respond to a department which yearly sends out sixty or seventy men to take part in its activities.

Queen's men are loyal to Queen's, to their chosen life-work, but they are not so clannish but that they can recognize the good work of others.

In that spirit Queen's graduates have made good—they are benefiting; so will Queen's.

## INDUSTRIAL EDUCATION.

K. A. Mackenzie, B.A.Sc., in Applied Science.

Beyond all question the movement for the improvement and extension of education along technical and industrial lines has come to stay. Each country must choose for itself whether it is to keep up with the procession or drop out of it; no country has any other choice left. On the broad lines of technical education Canada is twenty years behind Europe and at least ten years behind the United States.

The example of Germany is continually quoted in furtherance of all appeals for advancement along these educational lines. In Germany the education is threefold—the masses or the ordinary laboring man; the university or the engineer; and, lastly, the manufacturer. All will admit the extent to which Germany has succeeded in every branch of industry to which scientific method is applicable; and at the present day that includes all industries. It is just a question how much of this success is due to secondary education. The fact is that the German labor material is somewhat different from the English. The German will apply himself and work harder than the average Canadian, and this in some measure is the secret of German success. The average Canadian is just as intelligent, just as ingenious, and besides has infinitely more initiative than the average German.

Many claim that the real secret of German success lies in higher technical education; i.e., in the education

of the German engineers, given at the great engineering laboratories of the Fatherland and in the research laboratories of the large industrial corporations, manned by the graduates of these universities. Does not a great measure of German success lie in the fact that they can in a great number of cases produce better goods at less cost, through improved processes, which are the result of careful, continuous and painstaking scientific research? In Canada in a great number of cases the difference between failure and success to produce dividends, does not lie in the cost of raw material, high wages or in imperfect factory organization, but in the wastes, in the processes of manufacturing and in the treatment of the bye-products.

Supposing the Government aid secondary technical education to produce intelligently trained workmen and our universities continue to turn out men prepared to become engineers, thoroughly trained to direct the product of our technical schools, are our manufacturers educated to the point of making use of them?

Up to the present it is a lamentable fact that our industrial corporations refuse to give our young graduates a fair show, and consequently many of our brightest graduates are still drifting across the line, where their abilities are recognized and their services properly remunerated. In the United States the engineering faculties of universities are turning out six or seven thousand graduates every year, and they are all snapped up immediately by manufacturers, railroad companies and engineering corporations. In fact, most of the best institutions cannot supply the demand for engineers and chemists of all sorts and students who have been trained along scientific lines. These men go into manufacturing establishments, and if they are the right kind and have been properly trained, the manufacturer is regarded as short-sighted, indeed, who does not realize the man's ability and give him an opportunity to do the work he is especially fitted for. Take the Steel Corporation—the great Trust—about which so much is said. It is largely manned by young men—men who have come out of colleges within the last ten years. Some not over twenty-five or twenty-six years of age are superintending some of their finest plants and getting $6,000 to $8,000 a year. These men never received any training at all except the college training, and then went in at the bottom of the Steel Corporation's works. Their ability was soon recognized, and they were pushed on. It would probably be a revelation to some to see how young the men are who are in charge of these works.

Canadian interests seem slow to follow in the footsteps of their fellows across the line, but conditions are rapidly approaching which must make some change expedient. We are rapidly approaching the condition the United States reached ten years ago. "A wealth of raw material was ready to hand. An excessive tariff, a facility for business intrigue, which compensated for waste in the factory by combinations to eliminate competition, and the needs of an expanding and not too particular population; all these combined until a few years ago to cause waste in manufacture. Then came over-production, in business intrigue there was no more to learn, raw material had accumulated in the hands of the few, and the tariff, high as it was, could no longer exclude many goods made under scientific supervision. American manufacture was approaching a crisis, and began to realize that safety lay only in efficiency. To-day few men have any idea of the ever-increasing anxiety of the American manufacturer to secure factory efficiency." Already the supply of research chemists, etc., is inadequate, and during the next few years the need must be increased.

It would be interesting to know the reason of the lack of intercourse between our Canadian industrial corporations and our universities. Does it lie in the conservatism of the manufacturer or in the inefficiency of our graduates? Assuredly not the later, for our men go across the line and hold their own with the best. Some Canadian industries are using a large number of our men, but these, like the Westinghouse Company, are Canadian branches of American corporations.

A canvass of our leading business men has revealed a remarkable ignorance of just what our universities are doing along the line of technical and engineering education. Their knowledge of student action is confined to athletics and highly-colored accounts of street rowdyism.

## EDITORIAL NOTES.

The total tonnage of freight handled by Canadian canals for the season just closed was 32,735,898, as compared with 17,103,613 last year, or an increase of 15,632,285. The increase in the traffic of the "Soo" Canal alone was 14,533,611. The Welland Canal showed an increase of 308,944 as compared with last year. The only canal which shows a decrease in traffic is the Trent, which dropped behind last year's record by 21,738 tons.

* * * *

On January 4th the Railway Commissioners for Canada will consider the advisability of issuing an order prohibiting brakemen from riding on the top of freight cars. Such an order has long been required. In countries where the traffic is much heavier than in America the movement of trains is accomplished without standing or running over the top, and it can be successfully worked out here. Such an order would make it possible to reduce the overhead bridge clearance to about seventeen feet, thus making it possible to more easily do away with many level crossings.

## COMING MEETINGS.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton, H. Moore, Butte.

**American Association for the Advancement of Science.**—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

**American Society of Agricultural Engineers.**—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

**American Society of Engineering Contractors.**—Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secretary, Daniel J. Hauer, Park Row Building, New York, N.Y.

**Indiana Engineering Society.**—January 14-16. Annual convention at Indianapolis, Ind. Secretary, Chas. Brossmann, Union Trust Building, Indianapolis, Ind.

**Michigan Engineering Society.**—January 12-14. Annual meeting at Lansing, Mich. Secretary, Alba L. Holmes, 574 Wealthy Ave., Grand Rapids, Mich.

## STRENGTH OF BRITISH COLUMBIA TIMBER.

Showing the weights, specific gravities, deflection, breaking and crushing loads of some of the British Columbia woods. The pieces tested for transverse strength were one inch square, with a span of one foot, supported at both ends and loaded at the centre. The pieces tested for crushing were rectangular, and twice as long as they were thick. All pieces were fair average specimens of timber, partly seasoned, but free from knots and flaws. The results obtained from exceptionally good or bad specimens are not included in this table.

| Description of Timber. | | | Weight of a cubic foot in lbs. | Specific Gravity. | Mean Deflection of Inches. | | | | | | | | | | Highest breaking load. | Lowest breaking load. | Mean breaking load. | Mean crushing load in lbs. per sq. in. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 200 lbs. | 250 lbs. | 300 lbs. | 350 lbs. | 400 lbs. | 450 lbs. | 500 lbs. | 550 lbs. | 600 lbs. | 650 lbs. | | | | End-wise. | Side-wise. |
| Alder | (Anus rubra) | Bongard | 32.16 | .5158 | .092 | .... | .177 | .... | .158 | .2 | .25 | .... | .... | .... | 600 | 530 | 567 | 6500 | 1500 |
| Arbutus | (Arbutus Menziessii) | Pursh | 53.29 | .8547 | .... | .... | .... | .... | .... | .... | ... | .... | .... | .... | ... | ... | ... | 5900 | 1600 |
| Birch | (Betula papyrifera) | Marsh | 37.57 | .6025 | .05 | .087 | .1 | .117 | .142 | .... | .2 | .325 | .25 | .... | 660 | 630 | 650 | 7000 | 1750 |
| Cedar | (Thuga gigantea) | Nutt | 24.95 | .4001 | .1 | .133 | .158 | .2 | .25 | .... | ... | .... | .... | .... | 460 | 450 | 453 | 5500 | 1500 |
| Crab Apple | (Pirus rivularis) | Dougl | 50.21 | .8052 | .... | .... | .... | .... | .... | .... | ... | .... | .... | .... | ... | ... | ... | .... | .... |
| Cypress | (Chamæcyparis nutkaensis) | Spach | 31.21 | .5005 | .05 | .... | .082 | .147 | .... | .15 | .2 | .... | .25 | .... | 790 | 089 | 693 | 5900 | 1400 |
| *Fir, Red | (Pseudotsuga Douglassi) | Carriere | 34. | .5453 | ... | .075 | .09 | .114 | .119 | .... | .181 | .2 | .25 | .31 | 650 | 600 | 638 | 7000 | 1750 |
| Hemlock | (Tusga Martensina) | Carriere | 31.41 | .5037 | .09 | .1 | .14 | .18 | .... | .... | ... | .... | .... | .... | 420 | 380 | 400 | 5000 | 1000 |
| Maple | (Acer Marcrophyllium) | Pursh | 37.41 | .5999 | 063 | .... | .113 | .15 | .2 | .... | .27 | .... | .... | .... | 610 | 550 | 580 | 7000 | 1500 |
| Oak | (Quercus Garryana) | Dougl | 51.73 | .8296 | .06 | .16 | .228 | .312 | .344 | .354 | .458 | .... | .... | .... | 550 | 550 | 550 | 6500 | 1000 |
| Pine, White | (Pinus Monticola) | Dougl | 27.79 | .4457 | .1 | .125 | .15 | .2 | .25 | .... | ... | .... | .... | .... | 500 | 400 | 473 | 6500 | 1000 |
| Spruce | (Picea Sitchensis) | Carriere | 25.88 | .4150 | .1 | .... | .15 | .2 | .3 | .... | ... | .... | .... | .... | 440 | 420 | 427 | 5000 | 1000 |
| White Thorn | (Cratœgus Douglasii) | Lindi | 51.04 | .8185 | .... | .... | .... | .... | .... | .... | ... | .... | .... | .... | ... | ... | ... | 5200 | 1600 |
| Yew | (Taxus Brevitolia) | Nutt | 49.05 | .7865 | .... | .... | .... | .... | .... | .... | ... | .... | .... | .... | ... | ... | ... | 5900 | 2400 |

*Now frequently known as Abies D.

(By the courtesy of Edward Mohun, C.E.)

## PRECIPITATION FOR NOVEMBER.

During November an exceptionally heavy rainfall occurred over the southern coast districts of British Columbia, the total amount averaging nearly twice the normal quantity. From Ontario to the Maritime Provinces, with few exceptions, the fall exceeded the average, whereas it was almost generally deficient over the Prairie Provinces.

Snow fell occasionally in all the provinces, and on the last day of the month from 1 to 8 inches were reported to be on the ground in the West, and from 1 to 4 inches in Quebec.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for November.

Ten inches of snow is calculated as being the equivalent of one inch of rain.

| Station | Depth in inches | Departure from the average of twenty years |
|---|---|---|
| Calgary, Alta. | 0.20 | — 0.52 |
| Edmonton, Alta | 1.20 | + 0.36 |
| Swift Current, Sask. | 0.40 | — 0.25 |
| Winnipeg, Man. | 0.90 | — 0.18 |
| Port Stanley, Ont. | 4.10 | + 1.09 |
| Toronto, Ont. | 3.37 | + 0.70 |
| Parry Sound, Ont. | 2.80 | — 1.20 |
| Ottawa, Ont. | 3.70 | + 1.35 |
| Kingston, Ont. | 3.80 | + 1.21 |
| Montreal, Que. | 4.10 | + 0.66 |
| Quebec, Que. | 3.70 | + 0.63 |
| Chatham, N.B. | 4.20 | + 0.50 |
| Halifax, N.S. | 5.00 | — 0.64 |
| Victoria, B.C. | 11.50 | + 5.43 |
| Kamloops, B.C. | 0.80 | - - 0.32 |

## FACTORY POWER.

The English Textile Committee were appointed to make an investigation and report upon the adaptability of electric power for driving purposes in the factories of north England. The report states in part:—(1) In good installations there is practically no difference in cyclical variation between mechanical and electrical transmission when measured at the end nearest the main drive. (2) Any initial cyclical variation which may exist at the driving end is liable to be increased if transmitted through long shafts. (3) So far as any irregularity is concerned (excluding breakdowns) electrical transmission will maintain its condition better than mechanical transmission. (4) In modern textile factories of ordinary dimensions, and where the power is generated on the site, power is conveyed with less loss by mechanical than by electrical transmission, but where the plan of the buildings involves awkward angles of drives or irregular arrangement of machinery, the saving in power by electrical transmission begins to appear.

The question of the adoption of electrical or mechanical driving is largely one of cost. By adopting electric driving the following advantages can be obtained: (1) Ease of checking daily power required for running individual machines and departments. (2) Ability to run only a portion of the plant. With mechanical transmission the same object may be attained by the judicious application of clutches and similar devices. (3) Reduction in the number of belts, shafts, gears, etc. (4) Ease of regulating the speed and of introducing periodical speed variations if individual driving be adopted. (5) Ease of utilizing the available space to the best advantage. (6) Saving in the cost of the engine house and its foundations; or if an outside source of supply is available it should result in a reduction in the first cost of the installation and buildings due to the absence of the power-generating plant.

## SETTING PLANIMETER.

Alex. C. Craig.

The usual method of using this instrument seems to be to set the measuring wheel more or less accurately to zero by turning it with the fingers, a method not in the best interests of the instrument.

Others more conscientious, or moved by a desire for greater accuracy, take readings at the beginning and end of the operation.

The following method is commended to their attention:—

Hold the tracing point at the starting point and keep it there throughout the operation of setting. Then run the measuring wheel over the paper towards the zero position by

moving the needle point. Raising the wheel clear of the paper, put the instrument in its former position and repeat the operation as often as necessary to bring the wheel near the zero position. Then swing the instrument round the tracing point into a convenient position for measuring the area, keeping the measuring wheel clear of the paper the meanwhile. Make the final adjustment by slow careful movements of the needle point, and when the wheel exactly registers zero push the needle point into the paper.

The formidablity of the above description is equalled by the simplicity of the operation, as a few trials will demonstrate.

## WILL DEFAULT INTEREST

(The Monetary Times).

### On First Mortgage Bonds of Quebec and Lake St. John Railway—Company to be Reorganized.

That the Quebec and Lake St. John Railway Company will default on the payment of its first mortgage bonds on January 1st, 1910, and that the company will then be re-organized is the information learned on the best authority by the Monetary Times.

There is much speculation in London as to why the bonds of this company have severely and persistently declined. According to the latest mail advices from London, the price of the first mortgage bonds has dropped to 64. They have been as high as 90⅝ this year. The income bonds which have touched 24⅞ are quoted below 14. The highest price for the prior lien bonds this year has been 95⅝ and apparently in sympathy, these securities too have lost more than 10 points.

**Yearly and October Traffic Returns**

The traffic returns for October show gross receipts of $53,000, or a decrease of $11,900, making the aggregate gross receipts for the ten months to date $497,700, or a decrease of $32,600. These decreases, taken in conjunction with the position shown in the report, have given rise to misgivings. Gross earnings for 1908 amounted to $606,300, or a decrease of $56,900, and net earnings were only $78,900, a decrease of $84,500, or 51.78 per cent., over those for 1907. These net earnings, the report shows, did not cover the interest on the Prior Lien bonds, whose annual charge is $97,300, quite apart from the interest on the First Mortgage bonds, which requires $106,100. Allowing for the payment of the interest on the Prior Lien and First Mortgage bonds and other charges, apart from the Income bonds, there was a debit balance on the year of $148,700. The interest on the Prior Lien and First Mortgage bonds was paid apparently by means of loans, there being an item in the balance-sheet of $567,800 for advances on capital account re La Tuque and Gosford branches, and advances to meet interest charges and other pressing debts.

**Expectations Were Not Realized**

The directors state that a considerable portion of the loss on working expenses was incurred in connection with the La Tuque branch, which was undertaken on the assumption that its cost would be somewhat more than half of what proved to be the case, and in the expectation that the near approach of the completion of the Quebec Bridge would soon secure to the Company a large freight business from the paper and pulp mills that were to be constructed at La Tuque. But the collapse of the bridge, which postponed for several years the advantageous rates, in expectation of which the construction of the branch was undertaken, together with the depression in pulp and lumber industries, retarded the development of this property, and there is apparently no immediate prospect of extensive works at the La Tuque Falls being undertaken. Meanwhile, the directors continue, the outlay on maintenance and unremunerative service must be continued.

**Will Mean Reorganization**

Freight rates were raised in 1908. Had this not been done, the receipts from that traffic, say the directors, would only have been $269,600, or $79,200 less than they really were. For 1907 the net earnings were short of the amount required to pay all interest and charges other than that on income bonds by $40,100, but in 1906 they were $4,300 in excess.

The reasons accepted in London for the decline in the company's securities are the poor traffic returns and the unsatisfactory state of affairs shown in the last report. But the real reason the Monetary Times learns on the best authority is that the company will default on the payment and interest on its first mortgage bonds on January 1st. The interest on the prior lien bonds will be paid. A meeting of the shareholders and various owners will then be called to consider the re-organization of the company. The Railway Share and Trust Company represent the Quebec & Lake St. John road in London.

**History of the Road**

The road which is controlled by stock ownership, was incorporated in 1869 in Quebec and the first section was opened in 1871. The principal line runs from Quebec to Chicoutimi, Que., a distance of 227 miles. The total mileage is 286.5 miles with 39 miles of sidings. The equipment consists of 23 locomotives, 30 passenger cars, 745 freight and other cars and 28 service cars. A majority of the stock is owned by the same interests which control the Canadian Northern Quebec Railway Company. The bonded debt is made up of £500,000 prior lien 4s., dated April 1st, 1901, a first lien on the property of the company; £442,400 first 5s. due December 31st, 1924. (The interest on these bonds was at the rate of 4 per cent. per annum until July 1st, 1905), £640,000 non-cumulative income 6s.

The reorganization will probably put the road in better financial and physical shape.

## NEW INCORPORATIONS

James Richardson & Sons, Kingston, Ontario, $750,000; will carry on an elevator and warehouse business. H. W. Richardson is one of the incorporators.

The Torrey Asbestos Machinery Company, Limited, Montreal, Quebec, $50,000, will manufacture mining, milling and general machinery. Chas. G. Greenshields of Montreal, is a provisional director.

The Canada Bolt & Nut Company, Toronto, Ontario, $500,000; will carry on business of iron founders, manufacturing and dealing in all kinds of machinery and implements. Gerard B. Strathy, solicitor, Toronto, is interested.

Cartwright Automatic Press Company, Montreal, Que., $500,000; will carry on business of iron founders, makers of printing presses, etc. John W. Blair, advocate, Montreal, is a provisional director.

Baillot's Gas and Steel Machine Company, Montreal, $45,000, will construct and operate a steel plant. L. J. Beique advocate, is interested.

Yellowhead Coal Company, Limited, Toronto, Ontario, $2,000,000; Harcourt Ferguson, lawyer, is a provisional director.

## RECENT PATENTS.

The following patents have been issued, recently, through the agency of Fetherstonhaugh, Dennison & Company, patent solicitors, Liverpool and London and Globe Building, Montreal; Alex. Bertram, gypsum cement; J. M. Coleman, railway car construction and roller side bearings; Arthur Drowley and Donald D. McLean, snow plough; C. W. Metcalf, acetylene gas generators; R. Mortimer axe; R. D. Smith, weeder and cultivator; Harry Swales, wheel tyres; Lionel Turner, wheels for vehicles; S. A. Youngberg and J. B. Parnall, car fender.

Messrs. Marion & Marion, patent attorneys, Montreal and Washington, D.C., report the following Canadian patents recently secured through their agency: 121,939, F. Walton, London, England, road vehicle suspension arrangement; 122,019, Wilhelm Sonnberg, Charlottenburg, Germany, cages for ball bearings; 122,043, A. Allan and T. Bowling, Wellington, N.Z., fire alarm; 122,111, James A. McNeill, Digby, N.S., press stand and iron stand combined; 122,147, Arthur Wilzin, St. Quen (Seine), France, screw closure for bottles and other receptacles; 122,194, A. Baillot and A. Menager, Montreal, furnace grate.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## LOOKING BACKWARD.

In wishing the many readers of the "Sanitary Review" the Compliments of the Season and a prosperous New Year, we are inclined to look backwards over the few months since the management of The Canadian Engineer decided to devote a special part of this journal to Sanitary Engineering.

On March the 5th of this year we announced that in the future we proposed to publish in concrete and concise form up-to-date information on subjects affecting engineering hygiene. How far we have maintained this promise we must leave to the judgment of our readers.

On every hand, however, we have met with encouragement in our efforts, and we believe that, generally, engineers in Canada are taking an increasing interest in this particular line of work.

The problems affecting health engineering are always in any new country necessarily of slower development than purely utilitarian problems, such as questions of transit and power. Canada, however, appears to have arrived at that point of her history when it is possible to breathe more freely and take into consideration factors relating to conservation of natural resources. We see signs of this development on every hand. A tendency to think of the multitude instead of the individual, to consider the country as a whole instead of one little plot bounded by a deed of purchase, and to consider the value of the country as a continuous nation and not as an object for spoliation and a medium for getting rich quick.

The continued prosperity of the nation, just as with the individual, mainly lies in the factor of good health. Good health depends upon good air, pure food and wholesome hygienic surroundings. These are the most valuable assets of the people. They cannot be maintained by isolated or individual action, but are communal, depending upon joint action and unselfish enlightenment.

Valuable information has been added to our knowledge of sanitary engineering during the present year. It has been our endeavor to place before our readers as much of this knowledge as space would allow. In Europe, in the States and in Canada valuable papers have been contributed to societies by men whose grand motto is "Socialism in Knowledge."

For many of the valuable papers which we have been enabled to publish, either in full or in part, we are indebted to the research work of the American Technology Societies, and for many of the British papers we must acknowledge that splendidly conducted journal in its successful efforts to lead the van in sanitary engineering in England, viz., "The Surveyor and Municipal and County Engineer."

Among some of the papers contributed to societies, etc., during the past year we may mention as follows:—

"The Disinfection of Sewage and Sewage Filter Effluents," by Earle Bernard Phelps. This forms the most complete and valuable work yet produced on the subject.

"Purification Effects in Water by Storage," by Dr. A. C. Houston, Metropolitan Water Board Research Laboratories.

"The Practical Sterilization of Water and of Sewage Effluents," by H. C. N. Shenton, England.

"Sewage Purification versus Water Filtration," by Geo. C. Whipple, U.S.A.

"Bacteria in Sewer Air," by Prof. C. E. A. Winslow, U.S.A.

"The Divided Responsibility in Regard to Public Health," by Dr. C. A. Hodgetts, Canada.

"Water Supply," by Prof. Muir Edwards, Alberta, Canada.

"Water Sterilization at Boonton, N.J., by Geo. A. Johnson, C.E.

"Notes on the Separation of Solids from Sewage and Waste Liquors," by James P. Norrington, England.

"The Present Position of the Sewage Disposal Question," by W. J. Dibdin, England.

"The Chadwick Lectures," by Scott Moncrieff, England.

Among the many books published during the year on Sanitary Engineering we would again mention:—

"Principles of Sewage Treatment," Prof. Dunbar, Hamburg.

"Sanitary Engineering," Moore & Silcock, England.

The Sanitary Review has also endeavored to add its little share to the literature on the subject, and has published among its special articles continuous articles dealing with sewage disposal:—

"Septic Tank Process Relative to Treatment of Solids," by T. Aird Murray, C.E., Canada.

"Removal of Solids," by T. Aird Murray, C.E., Canada.

"Removal of Putrescibility," by T. Aird Murray, C.E., Canada.

Other special articles and editorials have dealt with "Purification of Water by Ozone," "Size of Sand Grains for Water Filtration," "Contact Beds versus Percolating Filters," "Water Supply and Infiltration Methods," "Is Sewerage a Paying Proposition?" etc.

It will be our endeavor during 1910 to maintain these columns as a review of what we consider best in sanitary thought. We would ask, however, Canadian engineers and all those interested in sanitary work to co-operate with us in sending in descriptions of works they have in hand or work in which they are interested. It is only by the publicity of knowledge and the scat-

tering of knowledge that the sum total of knowledge can grow and real progress be made in general improvement in methods of design and construction.

If we attempted to answer the question, In what particular aspect has the increased knowledge in sanitary engineering made itself manifest in 1909, we would answer, in an increase in modesty and greater recognition of limitations. It is no longer common to hear of the absolute solution of the sludge difficulty, of the total disappearance of everything organic, of wonderful bacteria, which eat up everything and nothing remains, of the total destruction of pathogens, either in tanks or filters, of a liquid effluent equal in every respect to good drinking water. All these assumptions are fast becoming things of the past. They were but the optimistic products of half knowledge. Even the word sterilization is being modified to the reasonable term disinfection. But having learned more definitely the reality of limitations, we are also learning in what manner these limitations can be modified. The year 1910 will see great advance made in the science of sanitary engineering.

## A TOWN ENGINEER'S SALARY.

At times we hear murmurs of discontent from Canadian engineers because of the difficulty of persuading some practical people that advice (the result of special scientific and technical training) is something which should command a monetary value. However, we have not yet been able to report of any Canadian municipality as the "Surveyor and Municipal and County Engineer" journal reports in its issue of 3rd inst.

We occasionally hear of starvation wages and the difficulty of eking out an existence in the Old Country, and as an example which, we trust, is remarkable as an exception we quote this interesting case, vouched for by the above journal:—

"At an inquiry recently held by Mr. P. M. Crosthwaite, a Local Government Board inspector, into the details of a loan for which official sanction was sought by the Okehampton Corporation, a request was urged by the town clerk that the borough surveyor's remuneration should come out of the proposed loan. The inspector stated that this was contrary to the Local Government Board's practice. Replying to a question, the borough surveyor, Mr. F. J. Worden, said he received $12.50 per quarter as surveyor. "Do you do any work for this?" Mr. Crosthwaite asked, in terms that seem to suggest more than irony, while he added grimly: 'I suppose they cannot expect much.' In this supposition he would appear to be quite wrong, for the clerk promptly replied, 'I think they do.' Here, indeed, is an example for admiration of the inverse order, for it is surely a matter of difficulty to determine which to admire least, the effrontery of a municipal authority which offers such a 'salary,' or the excessive modesty of the official whose self-appreciation is such as to enable him to accept it. Now that we know the remuneration of the surveyor the public interest in the internal affairs of the Okehampton Corporation might be meticulously extended so as to inquire the salary by means of which the lucky office boy is assisted to lead a life of affluence and self-indulgence."

## THE SANITARY ENGINEER IN RELATION TO THE CHEMIST.*

The chemist can be of some help to the engineer when designing the works to purify a given sewage; such help can only be of use when the chemist has the confidence of the engineer with respect to the proposed scheme.

A sample of sewage is often sent to the chemist; all that he is asked to do is to analyse it; most probably the items of the analysis he gives are to the engineer of very little use—e.g., the total solids are given which includes grit and sludge, also that in solution, and presuming the engineer is proposing to construct grit tanks and sedimentation tanks, the total solids give him the combined quantity, and therefore he has no information from the analysis of the amount of grit to expect and the amount of sludge to clean out from his tanks. If the chemist was informed that two tanks for the separation of each class of solids were proposed to be constructed, he would know, if he had any practical experience of the subject, exactly what was required, and so be able to give the engineer a result of analysis of practical use.

With the experience gained during the past fifteen years by those who have studied and worked amongst sewage purification plants, the final results are not such chance results as formerly. A new works can be so constructed as to give any desired state of purification with certainty. To do this, much information must be gathered both of an engineering and chemical nature. With regard to the latter, the following points must be known: (1) Quality of the sewage both chemically and physically; (2) the final state of purification required under the circumstances. These having been obtained and combined with the engineering portion, would give the engineer data on which he could construct works to give the desired purification.

Where the works chemist has charge of the sewage purification plant, he must necessarily have some little knowledge of engineering, as he has often to do work that is more of an engineering nature than chemical, such as gauging the volume being treated, etc. With sewage purification, engineering is really more in evidence with respect to the physical side, but the works' chemist has also to study the physical portion in some degree to find out the cause of many of the effects he meets with. When the chemist has some little knowledge of engineering he can give his deductions a more practical value to the engineer.

Many results of analyses are made valueless for practical purposes through many causes, the following being a few:—Where a number of samples are taken at different parts of the process, due regard not being taken of the time of passage, such as through tanks, filters, etc., consequently the samples are not in series and cannot be strictly comparable; the taking of samples without any record of the conditions prevailing before or at the time which might alter the composition, and so not allow a proper deduction to be made from the results obtained; taking a sample in a dirty bottle; not filling the bottle when the amount of dissolved oxygen is required to be estimated, and many other details in which a sample may be spoiled.

To know exactly whether a purification plant is working to the best advantage, samples should be taken at regular intervals of time; a record kept of the working of the plant, so as to be available for reference in case of any deductions required from results obtained by analysis."

*Extracts from a paper by M. G. E. Farmer, F.C.S., chemist, Croyden Sewage Works.

## NEW YORK HARBOR AND SEWAGE TREATMENT.*

After describing the various sewer outlets into the rivers and harbor, it is stated that samples taken from the bottom of the lower Hudson River and various portions of New York Bay appeared to be sewage sludge, in a fairly advanced stage of decomposition. It is found as far out as the inner end of Ambrose Channel; it diminishes rapidly in volume toward the crest of the bar, and at the outer end of the channel the material dredged up appears to be clean sand.

Much evidence was found that near the mouths of sewers, under the piers, and in partly enclosed waters surrounding the harbor, the deposits of sewage sludge are great enough to require dredging at intervals, and at places the waters are so badly contaminated as to constitute a nuisance. On the other hand, in the open harbor and bay, but little inconvenience has as yet been felt. Colonel Black quotes evidence given by the engineers of the Passaic Valley Sewerage Commission that surface water in summer at ebb tide at Robbins Reef contains 88.5 per cent. of the normal quantity of oxygen, while the condition of the water will not be serious, it is, stated, until the oxygen is reduced below 50 per cent. of the normal. From the viewpoint of the general shoaling of the harbor to be produced by the sewerage projects, it is considered by Colonel Black that the increased cost of dredging the deposits from the navigable channels amounts to less than the cost of disposing of the sewage in some other manner.

The pollution of the waters of the harbor to an extent that would be prejudicial to commerce as well as to the interests of the people living and doing business along its shores is more important than the matter of shoaling, according to the report. After an examination of the evidence at hand Colonel Black accordingly stated in his June report that the untreated sewage from the Bronx Valley sewer could not be poured continuously into the river at a single point without creating a local nuisance, although the volume of water in the Hudson is sufficient to deal ultimately with such a discharge. He accordingly stated that a tank should be built of sufficient size to contain the total discharge for one day. This should be arranged to allow facilities for screening, sedimentation and septic action. In addition to this, the effluent could be further purified, he believed, by aerating it with air forced into the outfall pipes under some pressure. The outfall sewers should be arranged to distribute the sewage in deep water over a comparatively large area through numerous outlets. As the population increases, new tanks can be added, but in case permission for this type of disposal is granted the permit should carry with it the condition that the sewage which is discharged into the river should always have a given minimum standard of purity.

In the report dated October 4th the conclusion is reached that the purification of sewage before its discharge into the harbor, on the ground that it may contaminate shell-fish in waters receiving it, is not advisable. These waters are seriously contaminated by surface wash from all the populated areas surrounding the harbor, so that the complete purification of all sewage would not render them free from objection. The complete purification of sewage in thickly-populated districts along the water front is considered impracticable, owing to the excessive cost of the property necessary for the purpose. The problem, therefore, is to attain such a degree of partial purification of the sewage that its subsequent discharge into the harbor will not make the latter offensive. Colonel Black has accordingly recommended that sewage discharge should be permitted only under the following conditions:

(a) "The sewage effluent before discharge shall be purified to such an extent as to contain in a putrescible condition not more than 75 per cent. of the organic matter found in average American sewage, as described by Winslow & Phelps on pp. 13 et seq. of their "Report of Investigations in the Purification of Boston Sewage," published in Water Supply and Irrigation Paper No. 155, of the U.S. Geological Survey.

(b) "No solid material shall be present in the sewage at the point of discharge excepting as matter in suspension, and the particles of solid matter then in suspension shall be so small as not to be clearly noticeable when the sewage in a diluted form has reached the surface of the water near the point of discharge.

(c) "There shall be no escape of noxious gases at the surface of the water at the point of discharge.

(d) "No slick shall be apparent at the point of discharge.

(e) "The discharge shall be so distributed as to cause no apparent discoloration at the surface of the water.

(f) "It shall be further stipulated that, should a sewer be built and operated under these or similar conditions, the officials legally charged with the construction and operation of the said sewer system shall, whenever so required, furnish to the proper official or officials of the United States designated by the Secretary of War such expert and other assistants as the representatives of the United States may deem necessary to determine whether the conditions are being complied with."

*A digest from the Engineering Record of two recent reports.

## CONTROL OF WORKMANSHIP ON ASPHALT PAVEMENTS.*

By L. Kirschbraum, Municipal Asphalt Laboratory, Chicago,

(Continued from last week.)

This, in the course of years is absorbed into the top, softening it and resulting in displacement or grinding out. The only test of a good open binder is that it should appear, on close inspection with the eye, to be uniformly and well coated, and when rolled and cold, should sustain the traffic incidental to laying the top without breaking up. With closed binder, there is not so much danger of separation of the cement, but the point most generally overlooked is in getting a uniform amount of fine material mixed with the stone, and this can be accomplished only by receiving the stone and sand in separate bins and mixing them in uniform proportions. This material, when laid and compacted, should, on breaking, appear solid and well filled, but not over-filled.

The proper proportioning of the materials entering into the wearing surface presents the most difficulty, for the reason that the amounts of asphalt cement, filler and sand vary and are interdependent upon each other, according to the characteristics of each material. Failure to recognize this fact, and work by rule of thumb, has produced many unnecessary failures. Density, toughness and elasticity are the characteristics to be sought for in preparing a durable mixture, and wide latitude is usually allowed the contractor in producing this result. Unfortunately, such latitude often leads the contractor to economizing on such materials as increase the cost, so that it is much more satisfactory to

*From a paper in the Michigan Technic.

specify within reasonable limits, certain requirements of bitumen and aggregate as have been shown by actual practice to produce successful results. These requirements, as provided in the new specifications prepared for the city of Chicago, are as follows:

| | Per Cent. |
|---|---|
| Bitumen soluble in cold carbon bisulphide | 10.5—13 |
| Portland cement and mineral dust passing a 200 mesh sieve | 12.0—18 |
| Sand passing an 80 inch sieve | 18.0—18 |
| Sand passing a 40 mesh sieve | 30.0—50 |
| Sand passing a 10 mesh sieve | 8.0—20 |

The sieves being used in the order named.

A mixture prepared without discretion, to come within these limits, might still be unsatisfactory. For example, should the mineral aggregate grade according to the maximum coarseness allowable, a bitumen content of 13 per cent. would be entirely too much likewise an extremely fine aggregate would have more than the minimum percentage of bitumen to produce a satisfactory mixture. Given a sand of a definite grading and a specified amount of filler to be incorporated, the amount of asphalt cement to be used can be regulated by the appearance of a stain produced by compressing a portion of the hot mixture between a sheet of light manila paper. If the mixture is rich, the excessive amount of asphalt cement will stain the paper heavily; if dry, the stain will be light. In making this test, it is necessary to consider the temperature of the mixture tested and the manner in which the pressure is applied. A very hot sample and excessive pressure will indicate a degree of saturation not at all true, so that it is necessary to apply such test with discretion.

It is the duty of the inspectors at the plant to watch the surface mixture as produced, very carefully, and to make such rough tests as described above to ascertain its correct proportioning. When a mixture has once been established as satisfactory, it is their duty to see that the established proportions are uniformly mixed. The carelessness of the men employed in the actual mixing of the material is sometimes remarkable. The great desire at many plants is to turn the mixture out fast. The greater output means economy in cost of production, and in the attempt to hurry the mix the proportions are often inaccurately gauged and the material is imperfectly mixed. The measuring and weighing devices are liable to get out of order and register inaccurately, and many a street, the mixture of which has been planned with the best of intention, has been faulty for reasons of this nature. The inspector must see that nothing of this sort occurs, that the mixture is actually being produced according to approved proportions. While any error would eventually be checked up by the laboratory, in a large city it might be days before this were accomplished.

The temperature at which the mixture is produced is of great importance, and there is a tendency among most plant men to neglect this altogether, or to heat the mixture unnecessarily in order that it may work easier on the street. The minimum heat compatible with proper workmanship is desirable. There is no occasion for heating above such a temperature. A mixture may not be actually burned by an elevated temperature, for there is every stage of injury between being first-class and the final stage of being burned, and while a mixture may show very little evidence of heat injury, its ultimate life may nevertheless be seriously shortened. Inspectors are required to hold their mixtures at low workable temperatures, keeping the sand passing out of the dryers at such heat as to insure the desired temperature in the final mixture. Plant inspectors report daily on the following form:

**Report of Asphalt Plant.**

Plant No. 8 October, 14, 1908.

Asphalt Cement.

| Kettle No. | Lbs. Flux to 100 R. A. | Kind of Asphalt |
|---|---|---|
| 1 | 22 | Top, Trinidad |
| 2 | 22 | |
| 3 | 22½ | Binder Trinidad |

Kind of Flux, Texas

| Binder | Lbs. | Top | Lbs. |
|---|---|---|---|
| A. C. | 65 | A. C. | 165 |
| Sand | 105 | Dust | 110 |
| Stone | 815 | Cement | |
| | | Sand | 740 |
| Total per box | 985 | | 1,015 |

No. boxes binder, 42 — No. boxes top, 300

Sent to Lake Avenue, 37th Street to Oakwood Blvd. — Sent to Lake Avenue, 37th Street to Oakwood Blvd.

New materials received this day:
1 Car Trinidad Asphalt
3 Loads Stone Dust

Remarks .....

A. Smith, Inspector.

Samples of the mixture are sent in daily to the laboratory from the street in a special envelope giving necessary data as shown in the following form:

**City of Chicago Board of Local Improvements.**

Lab. No. ..... October 14, 1908.

Sample of Asphalt Top from Lake Avenue.

Between 37th and Oakwood Boulevard, opposite house No. 3,902 on west side of street .....

Here is inserted a plat of the square on which a star locates the place from which the sample was taken.

Load No. 18 — Remarks .....

Time 11.15 a.m. — .....

Plant 8 — O. H. Noyes, Sub-Paving Inspector.

The street inspection in the City of Chicago is under separate head.

These samples are analyzed and filed.

From the descriptions given it is possible to locate defective mixtures, and, further, at the end of the season, it is possible to make up plats of each street showing where various mixtures and various materials have been laid. To insist in this the plant inspectors are directed to locate in the street points where new materials or changes of mixture have been made, so that in after years it would be possible to judge of the causes of failure or success of any street with accurate knowledge of materials and conditions under which it was laid. A final record is made up and filed, giving complete data regarding the street, including plats, nature and analysis of all materials used in its production, with daily record of the composition of the mixture and any physical condition of base, sub-grade and traffic affecting the life of the pavement.

In conclusion may be emphasized the absolute necessity of keeping accurate records as described above. For scientific progress in this industry it is essential that the actual results obtained be closely observed, so that with known conditions it is possible to benefit by good results, to be able to reproduce them and to avoid such influences as are demonstrated to involve error and failure. An asphalt laboratory is valuable only for the practical results attained, and not for new theories evolved each year, unless such theories are sufficiently demonstrated by actual results obtained, under known conditions.

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### COST OF CONCRETE FENCE POSTS.

The cost of reinforced concrete fence posts depends in each case upon the cost of labor and materials, and must necessarily vary in different localities. An estimate in any particular case can be made as follows: One cubic yard of concrete will make 20 posts measuring 6 inches by 6 inches at bottom, 6 inches by 3 inches at top, and 7 feet long, and if mixed in the proportions 1:2½:5, requires approximately:—

| | |
|---|---|
| 1.16 barrels of cement at $2 | $2 32 |
| 0.44 cubic yard of sand at 75 cents | 33 |
| 0.88 cubic yard of gravel at 75 cents | 66 |
| Materials for 1 cubic yard concrete | $3 31 |
| Concrete for one post | $0 17 |
| 28 feet of 0.16-inch steel wire at 3 cents per pound | 06 |
| Total cost of concrete and metal for one post | $ 23 |

To this must be added the cost of mixing concrete, moulding and handling posts, and the cost of moulds, an addition which should not in any case exceed 7 cents, making a total of 30 cents per post.

### COST OF POWER.

Mr. Charles T. Main and F. M. Gunby divide the items entering into the cost of power into two classes in their paper, "Cost of Power for Various Industries Under Ordinary Conditions." After defining Independent Charges and Proportional Charges, mention is made of what Dr. Steinmotz calls the "Reliability Factor." The paper, which was recently read before the Boston Society of Civil Engineers, says; The cost of producing power may be divided into two parts:—

1st.—Independent Charges, or, the part which is independent of the output, embracing fixed charges on the plant, as interest, depreciation, insurance, and taxes, and to a certain extent, of repairs.

2nd.—Proportional Charges, or, the part which is proportional to the output, including such charges as coal, labor, supplies, etc.

Steam plants in general, may be said to have low independent charges, and high proportional or operating costs.

Water power plants are usually the reverse, with high fixed charge accounts and low operating costs.

Another item which should be mentioned as affecting the cost of power, is what Dr. Steinmetz calls "Reliability Factor," which takes into consideration the spare machinery needed to insure continuous service. The charges on this spare equipment are apt to have quite a bearing on the cost of power in a central station supplying power of public uses, where reliability must be one of the chief considerations, and more spare or duplicate plant is usually maintained than in a private plant.

The same factor, too, may have quite an important bearing on the value of a water power privilege, because generally speaking, a water power may have a low reliability factor, due to the fact that there is usually only one dam, one power house, and sometimes a long transmission line, and that there are certain elements of risk from floods, droughts, and other causes over which man has no control. It is true that some of these disadvantages practically disappear in large systems, but as a general thing, there is a feeling of greater confidence in the reliability of steam plant, in close connection with a manufacturing plant than with a remote water power development.

#### The Cost of Water Power.

The cost of water power depends upon a great variety of factors, but the essential feature is usually the fact as to whether the combined result of all these factors is such as to make the cost of the development per horse-power delivered, a reasonably small amount, so that fixed charges shall not be excessive. In the determination of the cost of power, the cost per horse-power of development should not be allowed to confuse or cause misrepresentation of the actual cost of power delivered. The larger the development installed, the smaller is the cost per horse-power of development, but it does not follow that the cost of delivered power will be smaller per horse-power. As one of my assistants said;—"The large development and small cost per horse-power of development looks good in New York where the securities must be sold."

After the engineers have made their estimates of the cost of physical structures for these modern developments, there must be added generous items for rights-of-way, and legal expenses, called by one of our men "illegal expenses."

It is neglect of the consideration of a few things like this that has caused several of the recent developments to get into disrepute.

There is an idea common to some people that if a development will cost $100 a horse-power for the development, if carried to its most economical point, that it will be a safe investment, but when it reaches $200 a horse-power it will be well to proceed cautiously before investing any money in it. There are sometimes exceptional markets, for example,—in mines and other remote places where power costs are high and where high prices can be obtained. Under such conditions, a large cost for development is warranted.

The estimates given a little farther on, for the cost of water power when the cost of development was taken at $75 a horse-power plus the supplementary steam power make the total cost of water and steam $15.38 a year per horse-power. With coal at $4 a ton, the cost of steam power alone was given as $20 a year per horse-power.

If the cost of the water-power development is taken at $100 a horse-power, the yearly cost of water and steam power would be $17.53.

If the cost of the water developments was $150 per horse-power, the yearly cost of water and steam power would be $22, which is more than the cost of steam alone with coal at $4 a ton.

As stated before for some particular uses, like mining, where there is no supply of wood and coal is expensive, a high cost of development is warranted, and a high price can be obtained for the power. For example, there is one development in Mexico, for which we were consulting engineers,

where the cost of power at the mines was from $150 to $200 a year, gold. A hydro-electric development was made and power delivered at $100 a horse-power, this making a great reduction in cost to the mine-owners and yielding a substantial profit to the electric company.

We once reported on a development in California which cost about $400 a horse-power to develop. A small portion of this power could be disposed of at the mines for $75 a horse-power with comparatively short transmission lines, but the remainder had to be carried a long distance and sold in competition with other power. The fixed charges alone on this development were at least $30 to $35 a year, and the running expenses were also high. It was impossible to produce power cheaply enough to compete with other sources of powers and pay the fixed charges on the investment.

### Value of Water Power.

The value of water power to various industries will vary in approximately the same ratio as the cost of producing power in some other way, if considered as power, pure and simple, without taking into consideration other important items affecting the business which are sometimes more vital than the cost of power itself.

To illustrate the value and cost of power under different conditions, it may be well to mention two recent cases which we have passed upon.

As consulting engineer for a hydro-electric company, we were asked to submit prices for electric power to a colored textile mill for which we were also engineers, and were engaged at that time in planning a new steam power plant for the textile mill. The price quoted was 1.2c. per kw. hour. As engineers for the textile mill, we were obliged to reply to ourselves as engineers for the hydro-electric company that we could not afford to accept the offer, the principal reasons being;—

First.—On account of the use of steam for manufacturing purposes, and of the water of condensation for dyeing that the net cost of steam power would be less than the price of hydro-electric power.

Second:—That it was better for the textile company to own and control its own plant, if it had the capital to build it, which it had, than to purchase current brought over many miles of pole line, and be tied up to some foreign company.

The cost of power per kilowatt at the switchboard from the hydro-electric company for the operating time of the mill was about $35 per kw. per year; and for the steam plant which the mill was proposing to install, this cost was about $34 per kw. year, but if the power had been bought from the hydro-electric company, the mill would have had to install and operate a boiler plant nearly as large as the one required for both power and manufacturing steam.

It was estimated that the use of the waste products from the steam plant would reduce the net cost of the power at least $8 per kw.

The other case was where we were also making plans for a plain cotton mill for a new steam plant and where there were offers from two hydro-electric companys to furnish power. One offer was promptly turned down, asking too high a price. A second offer was to furnish current at 1.2c. per kw. hour, which is the same price which we refused for the color mill. For a plain cotton mill, however, we concluded that it was proper to accept the offer at 1.2c. per kw. hour, and there has been a contract signed for the delivering of the current.

The principal reasons for accepting this offer, were:—

First.—1.2c. per kw. hour equal about $36 a kw. per year, or $48 per electric horse power delivered. This reduced back to 1 horse-power equals about $23.50 per year, which was very near the estimated cost of steam power for the quantity required, and at the price of coal for this particular industry.

Second:—The mill desired to postpone the expenditure necessary for the steam plant if it could be done without serious loss.

## TURNTABLE CONSTRUCTION WITH SOME DATA ON COSTS.*

The following questions were submitted by the committee and following are a few written answers:—

(1) Proper length, allowing for probable future increase in length of locomotives. (2) Plate girder tables, and cost. (3) Cast iron tables, and cost. (4) Gallows frame tables, and cost. (5) Other designs, and cost. (6) Foundation, circle wall, paving if any and pit drainage. (7) Power for operation; electricity, air and other power.

J. P. Canty, Boston & Maine R. R.—Anticipating the probable length of a turntable required for future locomotive service, is rather an uncertain problem just at this period. However, it is the opinion of many that, on the division where I am located, the lately purchased steam locomotives have apparently reached their economical limits in both length and weight, provided the class of traffic remains similar to that which is now being handled.

The largest engines on our division are turned easily on turntables 70 ft. long. This is now our standard length, and as far as we are able to predict, will answer for future requirements.

The steel work in these tables cost approximately $2,500 on board cars delivered to our road by the contracting bridge company. There is nothing unusual about the design. However, I will mention that we specify that four cast steel end wheels shall be furnished on each end of table and the centre pivot bearing shall be of the disc pattern; meaning that the table turns on a composition disc on top of the centre cast steel pivot casting, instead of on the familiar roller bearing.

Our turntable centre foundations have, of late, been made of concrete, being 10 x 10 ft. on bottom and bearing on piles when there is doubt about the earth being sufficiently solid to carry the maximum load on this area without settling. The bottom course of concrete is generally 2 ft. in depth. The foundation is then stepped 7½ ft. square by 2 ft. thick, and a granite cap 5 ft. square by 2 ft. in depth is placed on top to receive the cast steel centre pedestal.

There are 330 cu. yds. of masonry in our 70-ft. turntable pits. The whole outfit, including turning motor, costs us between $6,000 and $7,000. Figures vary for different locations, depending upon whether or not we are obliged to drive piles, provide expensive drainage, etc.

Practically all of these new outfits have been put in where older and smaller tables were installed and as the older tables were kept in service just as long as possible so as to avoid delays to engines, our work has always been made more expensive than if new tables were constructed where we would not be handicapped by keeping the old table in use.

We use gasoline power turning device.

The floors of the turntable pits are covered with a coal-tar concrete paving, about two and one-half inches thick, somewhat similar to that which is used extensively in small cities and towns in New England for sidewalk surfaces.

*Abridged from the committee report, of the American Railway Bridge and Building Association, Annual Convention, October 19, 1909.

This gives a fairly hard and elastic surface, and does not crack when soil underneath heaves with frost, and is comparatively smooth, so that it is easily kept clean, and snow may be removed from pit without much trouble. The cost is about fifty cents per square yard.

A. H. Beard, Philadelphia & Reading Ry.—The cost of our plate girder standard 75-ft. table in place ready for the track rails is $7,785.00, as follows:—

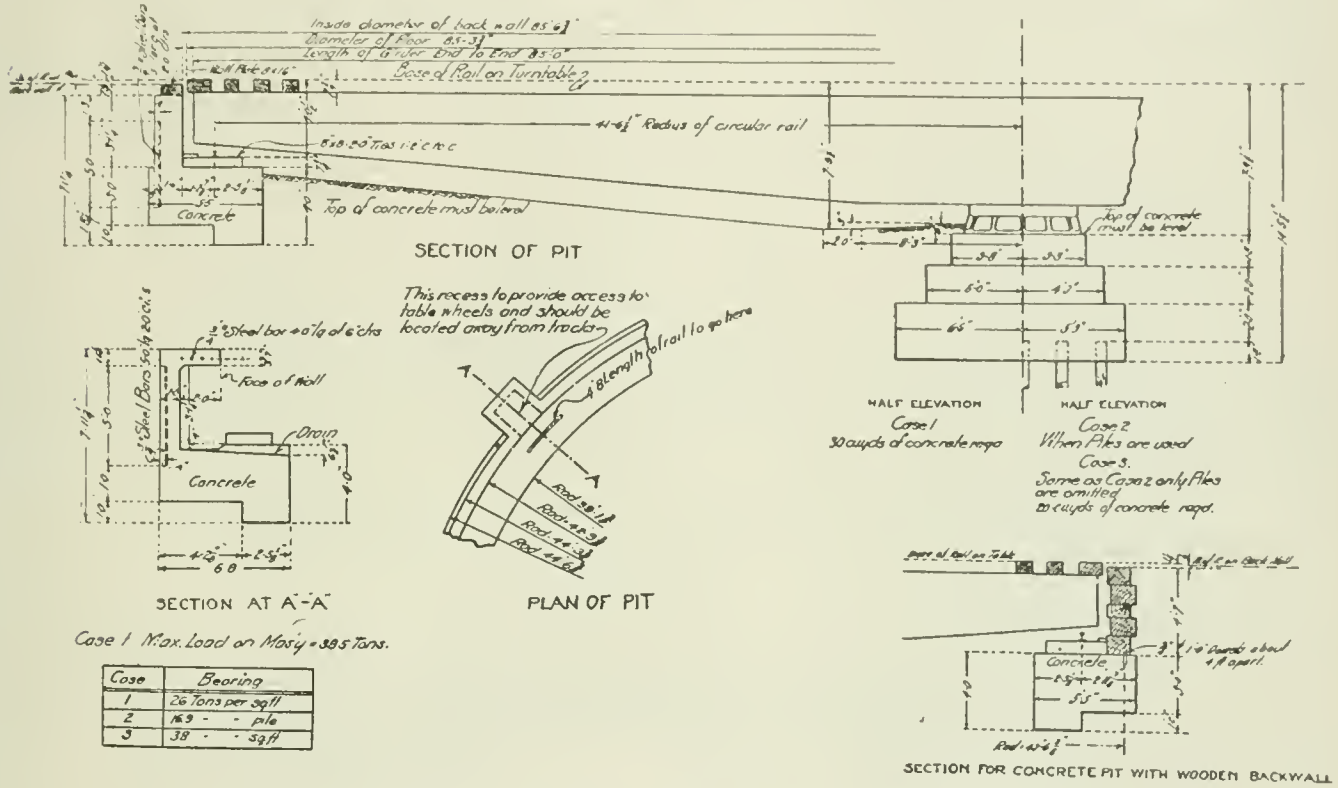
| | |
|---|---|
| Masonry | $2,500.00 |
| Miscellaneous | 500.00 |
| Table | 4,785.00 |
| | $7,785.00 |

A 65-ft. plate girder table has been in service at the roundhouse at Reading since 1897. This was manufactured by the Pottstown Bridge Co. Engines of all classes are turned on this table, the number turned every 24 hours (although the table is short for some engines) is 75 to 80. The cost of this table in place was $5,825. This table at present is operated by an 8-h.p. gasoline engine, manufactured by the Williamsport Gasoline Engine Co., the cost of same in place was a fraction over $1,000, and costs for operating about $165 per month, this includes labor, oil, gasoline and repairs; we are now arranging to install an electric motor on the same table to replace the gasoline engine.

E. E. Schall, Lehigh Valley R. R.—Our 80-ft. turntable is constructed as follows: Deck plate girders 5 ft. 6¼ ins. deep at centre and 2 ft. 8¼ ins. at ends, spaced 6 ft. c. to c., conical wheel centre bearings with live ring, built for a moving load of Cooper's E. 50 engines or 4,500 lbs. per lin. ft. of table. Cost about $3,200 delivered f.o.b. cars within 200 miles of bridge shop.

The centre foundations and circular rim walls are generally of concrete, the circular rail resting on short sawed ties. The top of rim is covered by a white oak timber coping to act as a cushion with rail tie-plated. The pit is paved with concrete about 6 ins. thick, and provided with drainage. For outlying districts, and tables not used extensively, the rim wall is at times omitted, using only a segmental wall at entrance and run off of table, using ballast under the ties of circular rail.

7. For operation we have in use electric motors, gasoline engine motors and air motors; all are giving satisfaction. When electric power is at hand, it is the most suitable power to use; when electric current must be purchased from other parties or when none is available, gasoline engine motors of from 8 to 10 h.p. will prove very satisfactory. The air motor will also prove efficient if properly installed and arranged to take proper adhesion on circular rail, obtaining a sufficient supply of air from locomotives to be turned, unless the air can be taken from a compressor near by. The air motor will not turn as many engines in a given time as either of the other two kinds, on account of the time required in making couplings, but for outlying districts it is the best motor attachment available at this time. The cost of installing one of the motors ranges from $900 to $1,200.


SECTION OF PIT
PLAN OF PIT
SECTION AT A'-A'
HALF ELEVATION
HALF ELEVATION
Case 1
Case 2
When Piles are used
Case 3.
Same as Case 2 only Piles are omitted
Concrete
Top of concrete must be level
Top of concrete must be laid
Face of Wall
Drain
Case 1 Max. Load on Masy = 385 Tons.
Case | Bearing
1 | 26 Tons per sq ft
2 | 16.9 - - pile
3 | 38 - - sq ft
SECTION FOR CONCRETE PIT WITH WOODEN BACKWALL

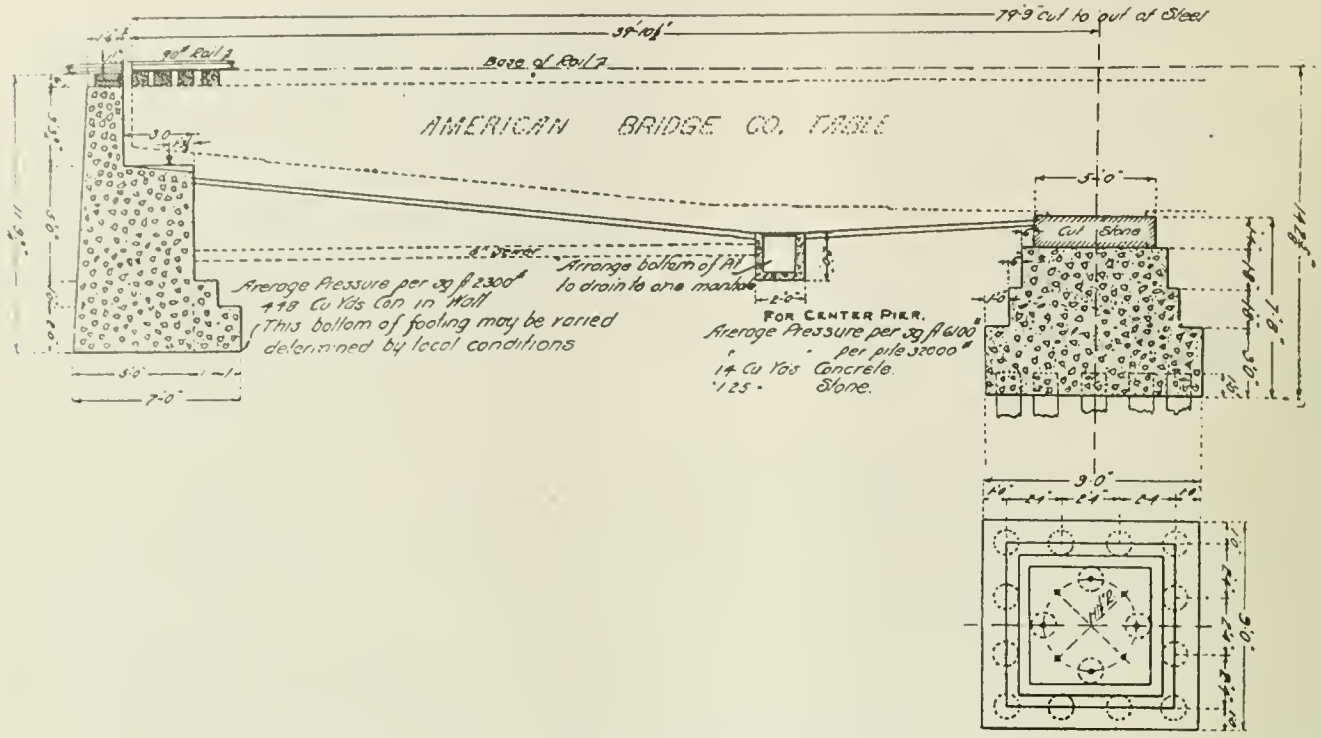
**Standard 85-ft. Deck Turntable, Chicago, Milwaukee, and St. Paul Ry.**

Moses Burpee, Bangor & Aroostock R. R.—I would think that 70 ft. length of turntable would be necessary for heavy locomotives for general use. Sometimes such length is necessary for cars, but usually it is not the length of wheel base which determines the length of turntable so much as their position in balancing on the table. In one case 70 ft. turntable installed, including masonry of foundation and ring, as well as drainage cost about $4,500. We usually find drainage of turntable necessary, and provide for it in all of our plans. We do not as yet use any kind of power for operating.

A. A. Wolf, Chicago, Milwaukee & St. Paul Ry.—We use 85-ft. turntables on mountain division where the heaviest power is used, and 75-ft. tables on other main line divisions. We have three types of the plate girder tables, which we distinguish as through, semi-through and deck. The reason for these various designs is occasioned by the difficulty in many places of getting drainage from the pit to a sufficient

depth to accommodate a deck table. These plate girder tables cost from $6,000 to $8,500, varying somewhat with local conditions, pertaining to the nature of foundations, etc. The labor amounts to from 35 to 40 per cent. of the total cost.

We use gasoline and electric motors only for power; the electric motor, in our estimation, furnishes the ideal power for turntable operation where it can be procured without excessive cost. At several of our division points we have our

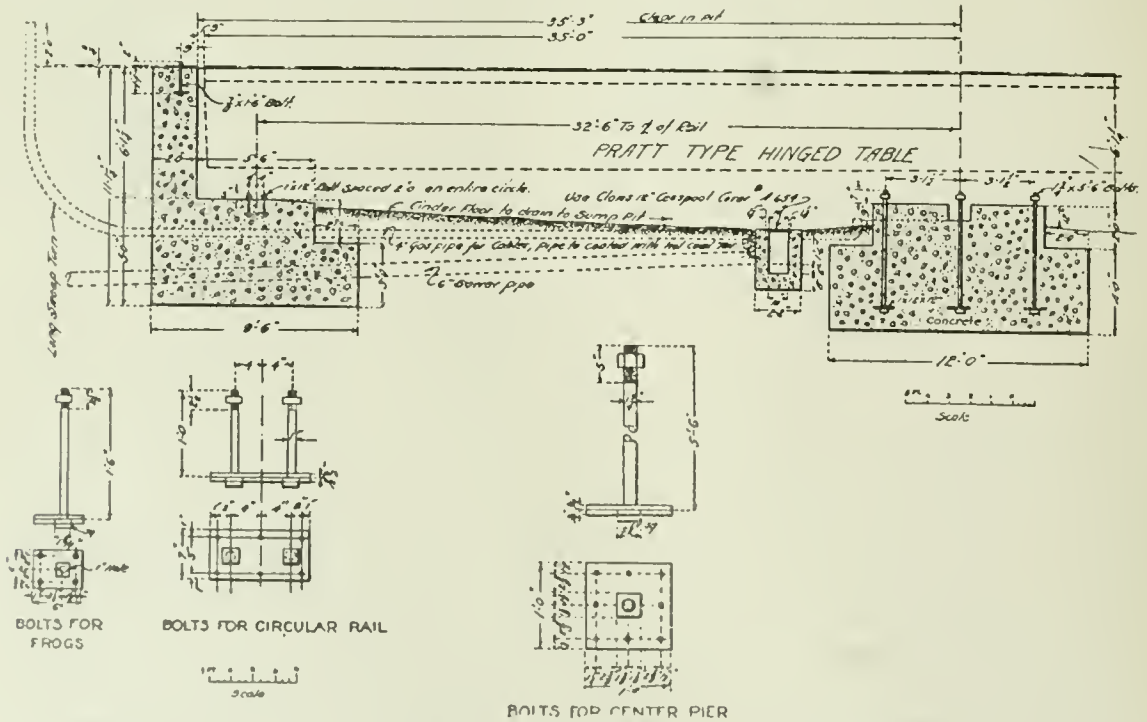



**Standard Pit for 80-ft. Turntable, Chicago and North Western Railway.**

For plate girder tables, we use a concrete centre pier, circle wall and circle rail foundation; the circle wall and foundation for circle rail being of monolithic construction. Piles are always used under centre foundation, except at places where solid ledge rock is found. Piling is used under circle wall except where rock or other firm soil is found. We do not make it a practice to pave the pits. Drainage is provided by means of connection to roundhouse sewer or to low adjacent ground, according to local conditions.

own generators and consequently the current required for operating turntable costs but very little.

I. O. Walker, Nashville, Chattancoga & St. Louis Ry.—Our standard length is 70 ft. Plate girder tables cost with ties, latches, etc., in place $3,200. Masonry and foundations $2,000. The cost of the masonry is extremely variable however.



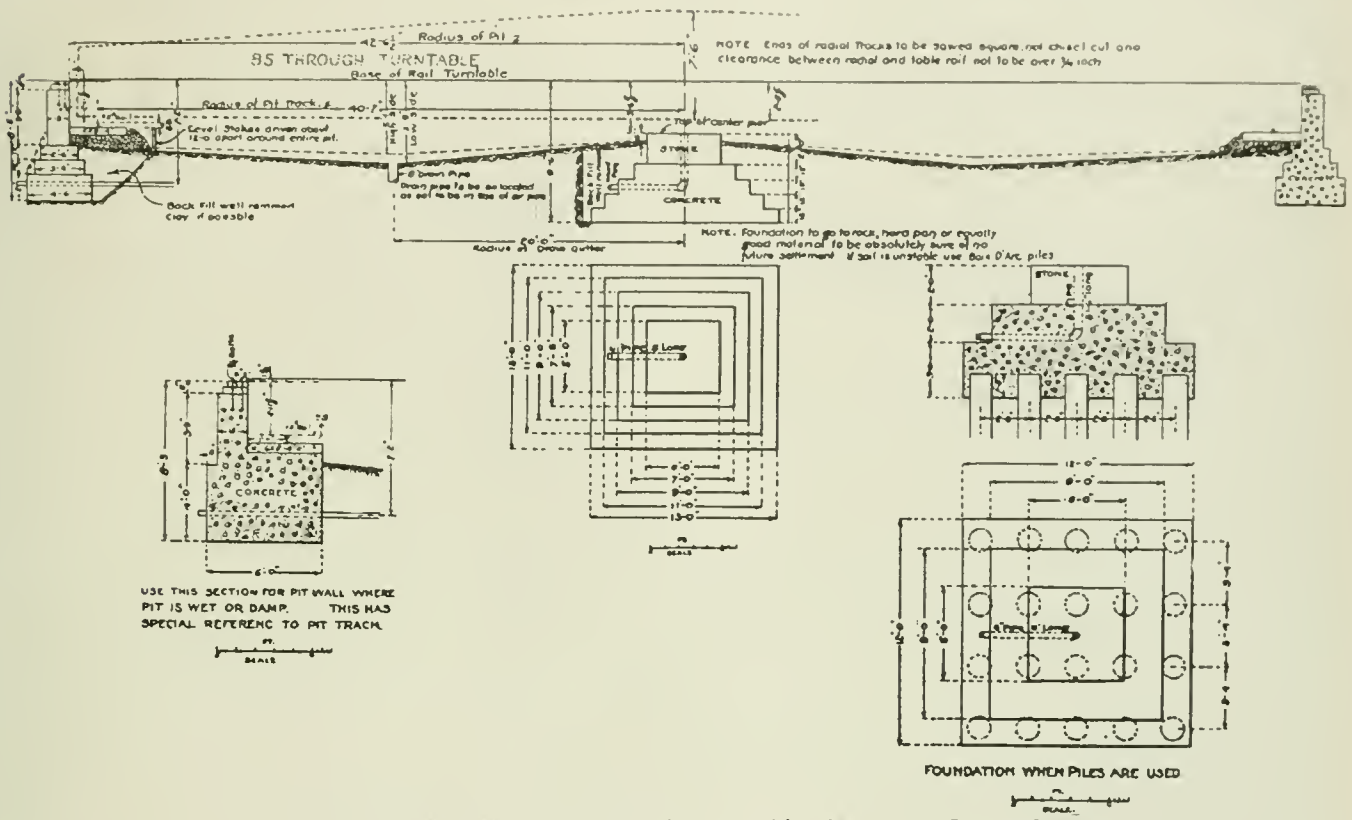

**Standard Pit for 70-ft. Pratt Type Turntable, Chicago, Lake Shore and Eastern Railway.**

W. T. Main, Chicago & North Western Ry.—Turntables newly installed in the future should be 80 ft. in length. A 70-ft. King Bridge Co., deck plate girder turntable installed

at Chicago Ave., in 1907, cost as follows:—

| | |
|---|---|
| Material | $2,570.46 |
| Labor | 2,262.00 |
| Total | $4,832.46 |

This table replaced an old 60-ft. deck plate girder and was installed under continuous traffic except for two days while new concrete centre pier was allowed to set. Over 400 engines were turned every 24 hours on old table during construction of new circle wall which will give some idea of conditions under which work was done and reason for high cost. Table is operated by 10 h.p. electric motor which was used on an old table but furnished with new frame. A 70-ft. King Bridge Co., deck plate girder turntable installed in 1907 cost as follows:—


85 THROUGH TURNTABLE
Base of Rail Turntable
Radius of Pit Tracks 40-7
Radius of Pit 42-7
Cedar Stakes driven about 12-0 apart around entire pit.
Back Fill well rammed clay if possible
6" Drain Pipe
Drain pipe to be so located as not to be in line of air pipe
Radius 50'-0" Stone curb
Top of Center pier
STONE
CONCRETE
NOTE Ends of radial tracks to be sawed square, not chisel cut and clearance between radial and table rail not to be over 1/4 inch
NOTE. Foundation to go to rock, hard pan or equally good material to be absolutely sure of no future settlement If soil is unstable use Box O'Arc piles
CONCRETE
USE THIS SECTION FOR PIT WALL WHERE PIT IS WET OR DAMP. THIS HAS SPECIAL REFERENC TO PIT TRACK.
STONE
STEEL & TIMBER
FOUNDATION WHEN PILES ARE USED

**Standard Pit and Masonry for 85-ft. Turntable, Sante Fe, Coast Lines.**

| | |
|---|---|
| Material | $2,890.00 |
| Labor | 2,262.00 |
| Total | $5,380.00 |

This table replaced an old 60-ft. Lassig plate girder and was installed under traffic in same manner as the one before mentioned. About $500 of the cost was due to renewal of radial tracks. The circle wall was built of concrete and the centre pier of concrete, reinforced with scrap rails in order to spread the load over old masonry foundation. The table is operated by 10 h.p. Pilling air motor and has six reservoirs under runways, the air being furnished by air compressor.

A 60-ft. Stroebel deck plate girder table installed at Chicago Ave., in 1899 on old masonry wall and new centre pier cost $2,500. A 60-ft. Greenleaf cast iron table installed at Milwaukee, 1899, including new centre pier, cost $3,100; the table alone cost $1,160. A 50-ft. gallows frame turntable installed at Evanston in 1896 with timber circle wall and centre pier cost $983.

Circle walls should preferably be built of concrete except when table is renewed under traffic, where rubble masonry can be used to better advantage while working in cramped space. Centre pier may require pile foundation unless subsoil is good, where a spread foundation of concrete or masonry 12-ft. square will serve. The advantage of paving in pit will hardly justify the additional expense though it is easier to keep pit clean when paved and helps the drainage. The best drainage possible should always be secured. Circle walls should have an offset at one point to allow of examination and repairs to end rollers and boxes, particularly where table has rollers between girders. Masonry circle rail seat should be extended at two points, diametrically opposite, to afford support for jacks for raising table and examining centre. This saves placing cribbing on soft ground when using jacks and renders the operation much safer.

Would recommend the use of electric motor for operating table wherever possible and where service demands the quick handling of engines; second choice, gasoline engine; third choice, air motor. The latter gives excellent service, where there is plenty of time for handling engines and where there is sufficient supply of compressed air which can be piped to reservoirs, but it is slow in operation where engine to be turned must supply the air.

B. J. Swatt, Contractor, Boone, Ia.—For western railways using the larger type of locomotives, I do not consider that the length of table should be less than 75 ft., and 80 ft. would be preferable, where the tendency is to an increase in the length of locomotives and tenders.

In my opinion plate girder tables are the best for general use, the deck type being the most satisfactory and also the most economical where drainage of the pit is practical. The cost will of course, depend on market value of iron, but will compare very favorably with any other type of table.

My experience with cast iron tables convinces me that they should never be used, except for lengths under 60 ft. and then only where the traffic is very light. All of the cast iron tables with which I have had anything to do had to be reinforced with heavy iron truss and even when so strengthened they were very unsatisfactory. I have no data on the cost of this type of table.

Gallows frame tables are, or at least they should be, relegated to the scrap heap by any railway that can afford an iron table.

The foundation for a table is in my opinion very important; piles should be driven in all cases where solid rock, hard clay or cemented gravel is not found. The piles for centre foundation should be spaced not more than 36 ins. apart and the number of piles should be not less than 20. Concrete is about the best, and at the same time the cheapest material that can be found on which to rest the centre casting. The depth of this should be not less than 4 ft. below the surface of the ground in the pit. The circle wall should have a good pile foundation, made of concrete, stone or vitrified brick; extending at least 4 ft. below the surface of the pit. Turntable pits should always be paved, either with brick or an equal thickness of concrete.

Pit drainage is very important; the size of the drain should be not less than 6 ins. in diameter and it should have a fall of not less than 2 ins. in 100 ft. The inlet should be at a depth of 1 ft. below the lowest part of the pit and should be provided with a good cast iron grating.

In countries where there is liability of snow storms, it is economical to provide a cover for the entire pit; unless this is done the cost of operation will be excessive and the delays in turning the power will be many. This covering can be made in sections of 1 in. boards and supported on a light frame work of timber or iron in such a manner as to be easily removed when not required.

Where electric power can be obtained at a reasonable rate, an electric motor should be used as it is not necessary to have an experienced man to run it and the cost of operating will be very small as compared with the loss of time of roundhouse men, extra help and the saving of time in turning.

A. O. Cunningham, Wabash R. R.—No table less than 75 ft. should be used. Deck tables of this length cost $2,600. The foundation of circular wall and paving should always be of concrete; pit should be well drained; the cost of this for 75-ft. deck table would be $3,700.

Electricity is the ideal power for operating a table. If this cannot be obtained a gasoline engine may be employed of about 6 h.p. The cost of the electrical equipment would be $1,150, and for the gasoline engine equipment $1,000.

W. H. Moore, New York, New Haven & Hartford R. R.—The standard length for turntables on our road is 75 ft., but we build some tables 80 ft. long. The approximate average cost for a 75-ft. deck plate girder turntable is about $3,500, and for a half through plate girder turntable about $5,750. The cost of foundation of the circular wall, etc., varies so much, depending on the nature of the ground, that it would be hardly proper to name any average. I may say, however, that for a concrete pit with granolithic floor and granite centre stone, in a location where there was good firm and requiring no piles and where drainage could be cheaply taken care of, the total cost is about $3,800. For power operations we use mostly gasoline motors; some air motors and electric motors where current can be conveniently obtained. The cost of power installation averages about $1,...

G. Vaill[illegible], New York, New Haven & Hartford R. R.—[illegible] requirements of modern engines, 75-ft. minimum; 80-ft. recommend; 75-ft. deck plate girder, erected complete $3,600, base of rail on table to top of centre pier, 6 ft. 4 ins.; base of rail on table to top of circular rail, 4 ft. 8 ins.; 75-ft. through plate girder, cost with floor erected complete, $5,750. Base of rail on table to top of centre pier, 3 ft. 11 ins.; base of rail to top of circular rail, 2 ft. 9 ins. The foundation, circular wall and centre pier are constructed of concrete; the pit is usually paved with granolithic pavement. The cost varies in accordance with local conditions, ranging from $2,500 to $4,000.

For power we use: (a) air supplied by the engine being turned; (b) air supplied from compressors in adjacent shops; (c) gasoline engines; (d) electric motors. Electric motors preferred where current is available; air motors, supplied by compressors, second, and gasoline motors third choice. The cost of power installation varies from $900 to $1,200.

C. F. Loweth, Chicago, Milwaukee & St. Paul Ry.—The proper length of table will depend on the character of the road; the grades, traffic conditions and the like will influence in the size of locomotives. For instance: on our Pacific Coast extension, west of the central portion of Montana, we are using 85-ft. tables, figuring that these will be of sufficient length to accommodate the Mallet type locomotives should we ever have occasion to use them on the several mountain divisions. Between central Montana and the Missouri River we are using 80-ft. tables, and the new ones on the old lines of our road are 75-ft. The cost of tables will depend a great deal on the design and capacities for which they are designed, and especially on the centres, where there is perhaps more than the usual variation in design and strength, and consequently cost.

N. F. Helmers, Northern Pacific Ry.—The Northern Pacific Railway are installing 80 and 85-ft. tables. I do not anticipate any power in the future, which will call for the use of a larger table. An 80-ft. through table, without the circle rail, and weighing 114,855 lbs. cost in place $4,600. Such a table was installed at Staples, Minn., with concrete circle wall and centre foundation. The masonry was done by contract, and the installation of the table by the company at an expense of $3.92 per ton. The framing of ties and other timber cost $4.05 per thousand feet. The cost was as follows:—

| | Labor. | Material |
|---|---|---|
| Turntable | $211.44 | $4,108.52 |
| False work | | 12.93 |
| Timber, ties, planking, etc. | 35.23 | 77.49 |
| Painting | 27.49 | 44.78 |
| | $274.16 | $4,333.72 |

Total cost (not including masonry), $4,607.88.

In 1908 an 80-ft. table of the same type was installed at Minneapolis replacing one 64 ft. in length. The foundation work was done under traffic, and the change of tables was done with a total interruption of 15 hours; itemized statement follows:

| | Labor. | Material. |
|---|---|---|
| Excavation | $ 463.04 | ..... |
| Gravel | 92.14 | ..... |
| Concrete work | 408.28 | $ 651.52 |
| Forms | 21.76 | 134.19 |
| Circle rail | 38.74 | ..... |
| Table proper | 361.36 | 4,040.95 |
| False work for curbing | ..... | ..... |
| Removal of old brick curbing | 104.42 | ..... |
| Cleaning girders | 37.98 | ..... |
| Painting | 23.76 | 21.04 |
| Ties and coping | 79.71 | 188.89 |

| | | |
|---|---|---|
| Engineering | | 14.66 |
| | $1,632.09 | $5,117.61 |

The total cost was $6,749.70.

I consider that ordinary conditions do not require the necessity of paving for the pit, but good drainage is essential in most cases.

For power we are using electricity and compressed air, while some of the 80 and 85-ft. tables are being turned by hand. Air motor in use at Jamestown, N.D., cost at St. Paul, $450; installation $19.81; total, $469.81. Electric tractor furnished by Nichols and Brother, cost $1,104.37; installation, $115.86; total, $1,220.23.

W. T. Powell, Colorado & Southern Ry.—The up-to-date table should be 80-ft. long, with a capacity for turning 200-ton engines. We installed recently an 80-ft. 200-ton through-plate girder table which cost as follows:—

| | |
|---|---|
| Table f.o.b., Denver, including circle rails | $3,700.00 |
| Material for concrete foundations and walls | 1,090.00 |
| Labor | 1,600.00 |
| Total cost | $6,390.00 |

This table replaced a 60-ft. table and we were compelled to excavate and put in the curbing under 42 tracks and keep them safe while in use. We drove 24 piles for centre foundation and capped it with a block of concrete 12 ft. square and 4 ft. thick; a deck table of this length and capacity would cost about $600 less. We use concrete entirely for masonry; rails are fastened with bolts and cast clips, the bolts being set in the concrete; no paving; drained when necessary. We use air power with a two cylinder motor.

J. S. Browne, New York, New Haven & Hartford R. R.—We have recently installed an 80-ft. table at Providence. The centre pier is of concrete, reinforced with steel rails, on account of the irregularity of the supporting material, as it was feared that the concrete might be fractured by the load if laid without re-enforcement. The outer wall of the pit and the paving are also of concrete.

While an accurate record was not kept of the cost it was approximately as follows:—

| | |
|---|---|
| 80-foot steel table delivered at Providence | $3,400.00 |
| Placing coping and circular rail and moving table into pit | 800.00 |
| Concrete in outer wall and centre, including forms | 2,800.00 |
| Excavation, including disposal of material | 1,500.00 |
| Paving | 300.00 |
| Drain pipe to connect with sewer | 200.00 |
| Total | $9,000.00 |

The work was done by the company's force, and the high cost of excavation was due to the fact that a portion of the work was done in freezing weather, and it was necessary to handle the material more than once before its final disposal by work trains.

The company's standard main line turntable is 75-ft. long, but 80 ft. is considered better at points where the largest type engines are turned, to permit of properly balancing them. Deck plate girder tables are used where sufficient depth is available without excessive cost, but where this is not feasible, half through plate girder tables are used. The superstructure of deck tables is about 30 per cent. cheaper than that of half through tables, but this saving is balanced by the greater cost of the pit, so that under ordinary conditions the total cost of these two types is about equal. Gasoline motors are generally used for power, although electric motors may be used to considerable extent in the future.

## CURRENT CONSUMPTION.*

By R. S. Pilcher (General Manager, Corporation Tramways, Aberdeen).

Everyone connected with the management of electric railways in these days realizes the importance of the subject of current consumption, whether the railway department has its own power station or not. The cost of electricity to any railway system may be the question of a profit or loss on the year's working. In Aberdeen the cost of current averages at 22 cents per unit, and the units consumed work out at 250 per car mile, making a cost of 26 cents per mile run. The proportion of this to our working expenses is 23 per cent., or more than half the cost of all our wages paid. I notice that in some of the largest towns in the country, the power expenses are about 30 per cent. of their total working expenses, and in one town they are as high as 35 per cent. I think you will agree with me that no effort should be spared in trying to prevent the systematic increases in current consumption which are to be seen all over the kingdom.

It is a fact, I believe, that the records of most towns in the United Kingdom and Ireland show an increase year by year in the consumption of current per car mile, and this is chiefly owing to track and car equipments becoming older, as well as to the great increase there has been in recent years in the number of top covered cars in use. I believe the increase through top covers is due in a small degree to the extra weight and windage of the covers, but in a larger degree to the extra carrying capacity of the cars in wet weather, and, in consequence, the greater number of stops which the cars have to make in a given time.

I have heard some railway officials speaking on this subject, who think that there is a great deal of current wasted through defective motor fields, badly worn pinions and gears, bent axles, etc., and I believe that in systems which have only been running a few years, much of the increased consumption may be due to this. But most of our systems have now been running over five years, and have replaced pinions, started to replace gears and field coils, in this way continually renewing the car equipments, so that I am inclined to think that the bringing forward of these causes of increased current consumption is rather apt to blind us to the true remedy, which, in my opinion, is to be found in the correct method of driving. We, in Aberdeen, could not afford to scrap any more field coils, and we get the full life from gears and pinions, but, we can afford to give a great deal of attention to the motormen.

Five years ago I experimented on one of the English railway systems with a view to saving current, and by instructing the motormen in the series parallel system of controlling motors, and by showing how it was possible to save current without decreasing the speed of cars, a reduction of over 7 per cent. was made.

In Aberdeen I started a similar system three years ago, which has also been very successful. In the first place, each motorman is brought into the office, and before a blackboard thoroughly instructed in the series parallel system of control by means of diagrams. I spent a great deal of time in illustrating the difference between two motors running in series and two motors running in parallel, also how it is that when motors are in series they only have half pressure, half speed and half the consumption of current. I find that it has to be

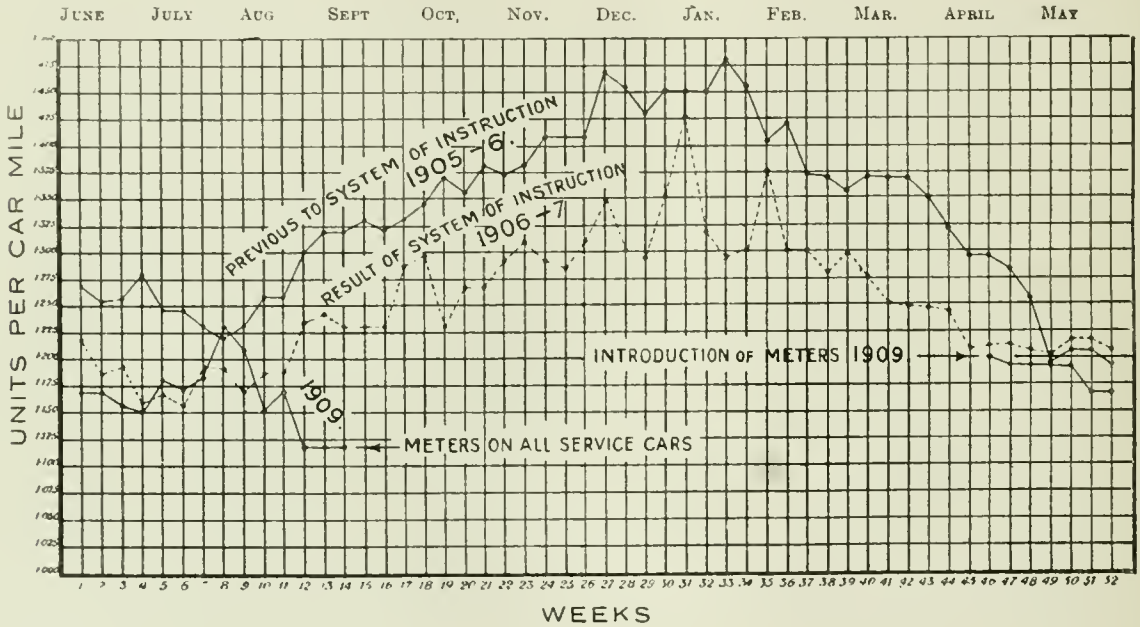
* Paper read at Eighth Annual Conference of Municipal Tramways Association.

very simply illustrated before the men can understand. My usual illustration takes the form of water, as I find that the men seem to grasp my meaning much sooner when referring to water than speaking of electricity.

The motormen seem to have great difficulty in realizing how it is that parallel consumes so much more than series, and especially how the first notch in series and the first notch in parallel consume more than the second and third notches. Each man is instructed how to use the momentum of his car to the best advantage, and he is shown how to keep up the same speed with less use of the power notches of controller. He is shown how the careful driver can, after arriving at the top speed, maintain it off the series position, whilst the careless driver would have his controller on parallel all the time. The men are also instructed not to run their cars on parallel, unless they have sufficiently clear space ahead to get the full benefit in speed of extra consumption. All the motormen are informed of the cost of current, and it never fails to impress them, because they previously did not appear to realize that electricity cost anything. Each motorman is put upon his honour to do the very best he can for the department, and he is informed of the reductions made. After having been thoroughly instructed in the office, he is given a printed instruction paper which shows where he should be running in parallel, and where in series, also where he should be coasting. I find that he soon learns the instructions, and gets into the habit of abiding by them. All our drivers are kept to their respective routes, otherwise I could not expect them to know the routes so well. A good inspector, who is tactful and not likely to ruffle the men, is put on the road to see that they carry out their instructions and to see there is no rushing to and from the different termini.

Previous to this system being introduced into Aberdeen, the rise in current consumption each year had varied between 6 and 12 per cent. per car mile, and immediately it was introduced there was a reduction. The first year the reduction was 6 per cent. on the previous year, or a saving of $3,200, in addition to which the gradual increase was checked. Since then we have maintained the same consumption per car mile, i.e., for three years, and as we have been adding to the number of top covered cars, at the rate of six each year, I consider that this is equivalent to a gradual reduction.

Some months back I experimented with 10 ampere-hour meters, each meter being placed on a different route, and I noticed a further decrease in the consumption of current. The Aberdeen tramways system has now got all its service cars fitted with ampere-hour meters, and the consumption of current is lower at present with 41 top covered cars than it has been for the last five years, although there were only three top covered cars in use five years ago. These meters have already paid for themselves by the reductions made. One of the meters had been on a car for a month, and, thinking that the consumption on this car was rather high, I changed the drivers, and the first week after the change, the current consumed by the new driver showed a decrease of $4, which has since been maintained. This will serve to show what could be done when applied to a large system. The current of consumption is shown each day and week against each man, a sense of healthy rivalry thus being created between the different men on each route in their effort to show the lowest consumption per car mile. I find that our motormen like the cars with the meters on them; they become interested in watching the current consumption each trip and each day, and I do not think it is necessary to become arbitrary or too strict with the men. I believe good results can be obtained without severe measures. Although we have saved several thousands of pounds in three years in Aberdeen, there has never been a single motorman suspended in connection with this subject. The average motorman is a little slow to understand the subject, but the explanation should be simplified. The main point is to get them interested in the subject, and when they understand they will certainly reduce the consumption of current.




I find that in Aberdeen the routes which use the most current are not always those routes which have the steepest gradients, but that the speed of the car and the number of stoppages has a material effect upon the current consumed. The cars which run the slowest, even although there are several fair gradients on the routes, use the least current, and on other routes where there is hardly any gradient the consumption is high, because of the high speed at which the cars have to travel, together with the greater number of stops.

Theory would teach us that the faster the car travels the more economical is the current consumption per car mile; in

practice I find just the opposite. It is of no use to give the efficiency of a car running in parallel against a car running in series, without taking into consideration the conditions of starting and stopping, combined with the fact that it is harder to keep time with a high average speed than with a low average speed, and will, in consequence, use more current when accelerating its speed. We have a route in Aberdeen on which seven cars operate. Some time back one car was taken off this route, but the six cars which were left used much more current than the seven cars had done, proving that in practice the faster the cars run the more current they will use per car mile.

Sometimes mechanical controller regulators are advocated to save current, but I think that they are of little use except to prevent the abuse of the equipments by notching up too fast. My own impression is that any system of electric tramways which has no method of checking current consumption will use at least 5 per cent. more current per car mile than a system which has a systematic check upon its drivers. Of course, I believe that in those towns where there are very many steep gradients and few level tracks, there is not so much scope for this subject as in fairly level towns. If current is to be saved without interfering with efficiency (and it can be saved), the first thing to do is to instruct your motormen specially on this subject, and follow this up by a direct check upon them. It matters little whether you use watt-hour meters, ampere-hour meters, or time-meters. I believe the same effect can be obtained by any of these. It is not so much a question of accurately measuring the consumption of current by each car, but rather of having a comparison day by day with other cars on the same route.

On dry days, or after several dry days, when there is a deal of dust accumulated about the rails, the current consumption rises upon the car meters, and as Aberdeen is fortunate enough to possess a special sprinkling car fitted with rail nozzles, which the cleansing department use for watering the streets, this water car is sent out to clean the rails.

Different rail cleaners are often advocated for the purpose of reducing current consumption, but I think that most of them, although they clear the groove, leave a lot of dirt and dust upon the tread of the rail in dry weather; therefore, I think that the best rail cleaner is a water car. Although the current consumed on a wet rail is less than on a dry rail, I find that on rainy days the consumption of current is higher that on dry days, but this is owing to the greater number of passengers carried at rush-hours, and, consequently, the greater number of stoppages.

In Aberdeen, simultaneously with the introduction of systematic supervision of the drivers, I noticed a great improvement in the time-keeping of cars; also, which is very important, a great reduction in motor troubles, the number of armatures in for repair being greatly decreased. The car repairs for Aberdeen last year stood at .41d. per car mile, and I believe this is largely due to the reduction in current consumed.

I think the question "which particular type of meter should be adopted?" is quite a secondary point. We in Aberdeen saved a great deal before adopting any meter. There is no doubt, however, that the meter is a most valuable part of our system of check now, and saves a great deal of supervision.

**CONSULT OUR CATALOGUE INDEX** on page 6. We can put you into immediate touch with the principal manufacturers of and dealers in all kinds of engineering and contracting equipment. A postcard to this department will insure the receipt of the desired catalogue.

## PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

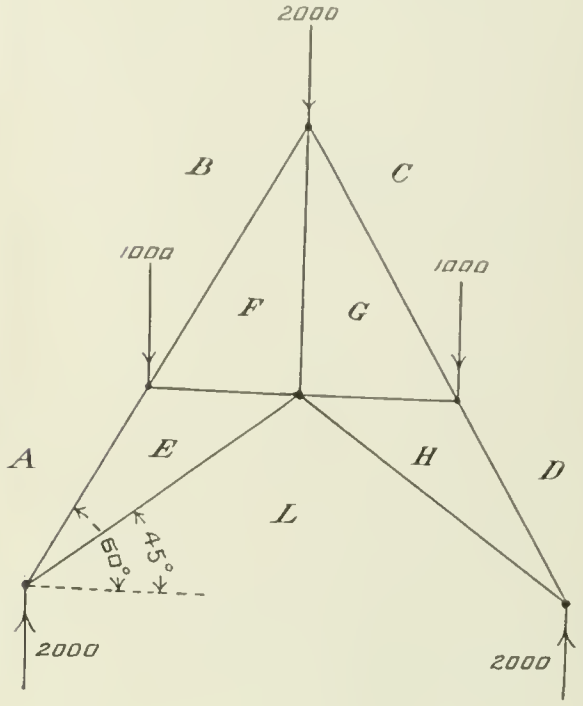



Fig. 96.

Considering the forces acting on the truss and applying the equation $\Sigma M = 0$, taking moments about a point in the line of action of either abutment reaction, it is seen that the abutment reactions are both equal to 2,000 pounds.

**Consider the forces acting at the point LHD** (Statical Diagram, Fig. 97). Since these forces are in equilibrium, $\Sigma X = 0$, $\Sigma Y = 0$, $\Sigma M = 0$.

$$\Sigma X = X_{LH} + X_{HD} + X_{DL} = 0.$$

LH and HD being both unknown, assume their X's positive.

$$LH \cos 45^\circ + HD \cos 60^\circ + 0 = 0.$$

$$LH \cdot \frac{1}{\sqrt{2}} + HD \cdot \frac{1}{2} = 0.$$

$$LH = \frac{\sqrt{2}}{1} \cdot \frac{HD}{2}.$$

$$= \frac{HD}{\sqrt{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.)$$

It is evident that in order to solve for the two unknowns, LH and HD, another equation must be formed in terms of the same unknowns, this equation to be used simultaneously with equation (1.). Using $\Sigma Y = 0$ as the other equation:—

$$\Sigma Y = Y_{LH} + Y_{HD} + Y_{DL} = 0.$$

Since the equations $\Sigma X$ and $\Sigma Y$ are being used simultaneously, we are not at liberty to assume the Y's of the unknown forces LH and HD positive (as would ordinarily be done) without first considering the assumptions in the first equation. **The assumptions as to the**

**signs of the Y's of the unknown forces must be in accordance with the assumptions as to the signs of the X's of the unknown forces in the first place.** Referring to Fig. 98, let AB represent the line of action of the force LH (Fig. 97), and, since the $X_{LH}$ was assumed positive, the line CB with sense mark to the right evidently represents the assumed $X_{LH}$. Now, although the magnitude of $X_{LH}$ is unknown, since the magnitude of the force LH is unknown, yet it is seen from Fig. 98 that, irrespective of the magnitude of $X_{LH}$, if the $X_{LH}$ is assumed positive, the $Y_{LH}$ must be assumed negative as represented by such a line as AC (Fig. 98). (It is seen from Fig. 98 that no matter what the length of the line representing $X_{LH}$ be, the line representing the corresponding $Y_{LH}$ will have its sense mark pointing downward in order to complete the diagram.)

In the same way, it is evident that $Y_{HD}$ must be assumed negative if $X_{HD}$ be primarily assumed positive.

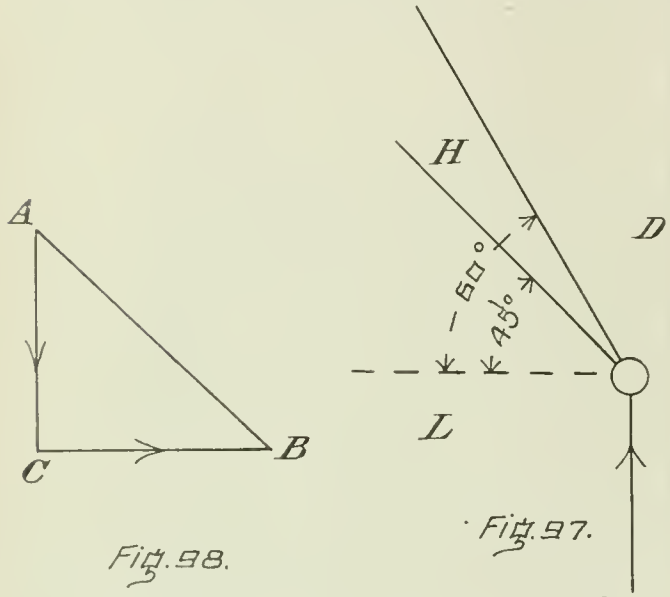



Fig. 98. Fig. 97.

$$\Sigma Y = -LH \sin 45° - HD \sin 60° + 2{,}000 = 0.$$

$$-LH \frac{1}{\sqrt{2}} - HD \frac{\sqrt{3}}{2} + 2{,}000 = 0 \ldots\ldots (2.)$$

Substitute value of LH from (1.) into (2.).

$$-\left(-\frac{HD}{\sqrt{2}}\right).\frac{1}{\sqrt{2}} - HD.\frac{\sqrt{3}}{2} - 2{,}000.$$

$$\frac{HD}{2} - \frac{HD}{2}.\sqrt{3} = 2{,}000.$$

$$\frac{HD}{2}(1 - \sqrt{3}) = 2.000.$$

Multiplying both sides of the equation by $-1$:—

$$\frac{HD}{2}(\sqrt{3} - 1) = 2.000.$$

$$HD = \frac{4{,}000}{(\sqrt{3} - 1)} \ldots\ldots (3.)$$

From the positive sign of the result, it is seen that the assumptions as to the $X_{HD}$ and $Y_{HD}$ are correct. **The $Y_{HD}$ was assumed negative and $X_{HD}$ positive,** which is seen to be correct; the force HD, therefore, acts against the point; i.e., the member HD is in compression $\frac{4{,}000}{(\sqrt{3} - 1)}$ pounds.

Substituting the value of HD from (3.) into (1.):—

$$LH = -\frac{HD}{\sqrt{2}} \ldots\ldots (1.)$$

By substitution:—

$$LH = -\frac{4{,}000}{(\sqrt{3} - 1)\sqrt{2}}$$

It is evident from the negative sign of the result that the assumed signs of $X_{LH}$ and $Y_{LH}$ are wrong; i.e., $X_{LH}$ is negative and $Y_{LH}$ positive. The force LH, therefore, acts away from the point; i.e., the member LH is in tension $\frac{4{,}000}{(\sqrt{3} - 1)\sqrt{2}}$ pounds.

The same results would have been obtained had the equation $\Sigma Y = 0$ been used first, although the work would have been slightly more involved. The point of the preceding discussion is that, **if the equations have to be used simultaneously, the assumptions as to signs in the second equation must be in accordance with the given lines of action of the unknown forces and the assumed signs in the first equation.**

The construction and loading of the truss (Fig. 96) are symmetrical about the same axis. From this fact we are at liberty to say that the left-hand half of the truss will have the same stress in any of its members as the corresponding members in the other half of the truss. It would, therefore, be unnecessary to consider the forces at the point LEA in order to find the stress in the members LE and EA (LE will be in tension and EA in compression to the same extent as the members LH and HD, respectively). It is advisable, however, that the reader go through the analytical determination of these stresses.

**Consider the forces acting at the point LEA.**

## REPORT OF THE COMMITTEE ON POWER DISTRIBUTION.*

**By James Heywood, Chairman; W. J. Harvie, C. W. Palmer, Jr., S. L. Foster, W. C. Matthews, and E. J. Dunne.**

The committee decided to work as closely as possible to the outline submitted by last year's committee, giving special attention to those subjects which were designated by the executive committee. It has been thought advisable to submit with this report a number of specifications for material used in power distribution.

### High Tension Feeders.

Underground high tension cables have passed the experimental stage, and are giving satisfactory service in a large number of installations. The majority of the latter installations have been made with paper insulation. The highest volage of which the committee has knowledge is 25,000, and this is rather the exception than the rule. From 11,000 to 13,200 seems to be the most popular range of voltage.

In Appendix A [Not republished.—Eds.] will be found a specification for use in purchasing high tension underground cables. In view of the high cost of cable of this kind, the committee recommends that in general cables be made large enough to accommodate future needs; in fact, in usual

* Abstract of report read before the American Street & Interurban Railway Engineering Association, at Denver, Colorado.

installations it is well to install as large a cable as can be pulled through the ducts. This applies to entire underground installations.

Rubber and cambric are sometimes used for high tension underground cables, and if it is desired to use rubber, the committee recommends that the specifications in Appendix B [Not republished.—Eds.] be used to determine the quality of rubber compound.

High tension cables should be protected outside the lead where they pass through manholes, the common practice being to cover the lead with woven asbestos saturated with a solution of silicate of soda. The silicate of soda solution should be omitted in manholes that are full of water. This method of protection is recommended by the committee.

Where overhead high tension transmission circuits are used, the committee recommends steel supports in the form of towers where the line is isolated, and when along the tracks to be supported from extensions to the structure that supports the trolley wires. All steel towers should be galvanized, and subjected to the test for galvanizing given in last year's report, to obtain the most economical results.

Some special conditions demand the use of wood poles instead of steel towers, for instance on streets where the line must be carried along the sidewalk, and in climates where wood is not subject to decay.

As illustrative of special conditions, Appendix C gives a discussion by S. L. Foster, of this committee, showing some results with moderately high tension transmission lines in California. [Appendix C presented elsewhere.—Eds.]

With the new form of suspension insulator, and with ten feet of vertical separation between conductors, the use of wood poles for even ordinary spans is out of the question when ample clearance between lowest conductor and foreign wires or even the earth is maintained. The steel tower or pole is practically invulnerable to fire and is safe from deterioration and from short circuits by climbing animals.

The suspended insulator is built up of a series of insulator units connected together by hooks and eyes. Each disc-shaped unit has a mechanical breaking strength factor of safety of from 25 to 50, even after all the flange has been broken off. In case of a broken or burned off conductor, this reserve strength in the insulator would take care of the unusual strain, and not result in a broken insulator or a split cross arm. The flexibility of the suspended type of insulator also raises the factor of safety. On one California 154-mile steel tower line now being operated at 75,000 volts and intended to be operated later at 110,000 volts, five units in series are used, each tested at 65,000 volts giving an ultimate factor of safety of three. On another 150-mile steel tower line in the same State with 60,000 volts at present and 100,000 volts as prospective, five units tested to 90,000 volts each are used, giving a factor of safety of 3.6. Another 13,200-volt transmission in the same locality contemplates a three-part insulator of a test voltage of 80,000, or a factor of 6.06. Assuming that city construction averages $50,000 per mile, and high tension insulators cost 40 cents each, the cost of high tension i nsulators is a little over 1/100 of 1 per cent. of the total cost of construction, exclusive of cars, buildings and power houses on a large street railway system there. Such being the case, the advance from an admittedly inadequate factor of 5.34 to one of 6.06, the sufficiency of which is yet to be demonstrated, seems not over-cautious in the light of the great importance of absolute continuity of service in heavy street railway operation demanded now.

Other qualifications of the suspended insulator are: Superior accessibility for cleaning and observation; and superior resistance to missiles.

If wood construction were to be attempted on a scale corresponding to that of the steel tower, the cost would probably exceed that of the steel tower and would last only eight or ten years, whereas the galvanized iron tower should last indefinitely. Also, greater durability of the conductor is assured when it is strung on suspended insulator because of less crystallization at the point of support. It has been the experience in California where after a year's operation on spans varying from 350 to 4,000 feet and towers varying from 50 to 300 feet high and 60,000 volt lines that no short circuits are made in high winds. As steel towers consist of many separate pieces which are only assembled when at the point of erection, it is easier to transport a tower piecemeal to a location difficult of access than it would be to transport a wooden pole of equal height.

### Low Tension Feeders.

The committee recommends the use of paper insulated and lead covered cable for underground service. Specifications for this material have been prepared. There are two methods of disposing of condemned un lerground cables, viz., scrapping and rehabilitation.

Where re-leading is practised, a small stock of cables is maintained. When a cable fails, the faulty section is replaced from stock, the bad piece re-leaded and placed in stock. It is also possible to splice two or more pieces of cable together and re-lead them, the outside diameter at the splice remaining the same as in the continuous cable.

When it is necessary to change large quantities of cable from one location to another, as for instance when a new substation is installed, the re-leading of cable becomes a very attractive method, as shown by Fig. 1. It is more economical to re-lead the large sizes, but when the size is small re-leading becomes more expensive than scrapping the old cable and purchasing new

A difference of opinion exists in reference to the use of concrete around wooden poles. Good results, however, have been obtained in San Francisco by means of concrete setting, poles having been in service fourteen years set in concrete and are still in good condition. These poles, however, were of redwood, which is not available in all parts of the country.

A patented process for reclaiming wood poles, which have been decayed at the butt, by means of reinforced concrete, has been brought to the attention of the committee. It is too early at this time to say what the results will be.

### Repair of Poles.

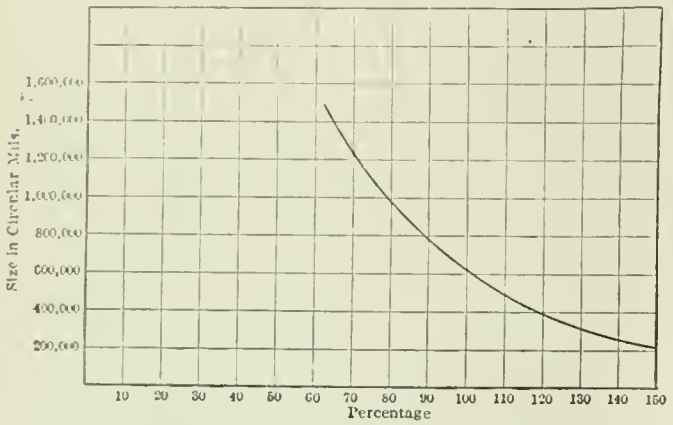
The principal seat of trouble in old poles is at the ground level, where the moisture lies the longest and either corrodes metal poles or rots wooden poles. In selecting a method for repair, the essentials are: The work should be done with common labor; no special tools should be required if possible; the fault should be entirely eliminated—i.e., further corrosion or rotting of the pole stopped; the repairs should be permanent, i.e., no further maintenance should be required; when complete the poles should be as strong as when new; the cost must be low. To attain this there are at present several methods in use:

One method, applicable to metal poles only, consists of filling the inside of the pole with grout in which steel rods are bedded. A second method, applicable to wooden poles only, consists of driving U-shaped rods around the pole at the point where the timber has been rotted away and then filling in space with concrete. A third method, applicable either to wooden or metal poles, consists of placing metal clamps and bolting these together. A fourth method, also applicable to either metal or wooden poles, consists of using a metal sleeve either of pipe section or split, depending on

the number of fixtures on the pole. This sleeve has a larger diameter than the pole, and is placed over the corroded or rotten portion of the pole, and the space between is filled in with some material.

Some of these methods have very serious objections.

In the first method, since the diameter of the pole is fixed, in order to obtain the desired strength of the original pole, computation shows that a considerable amount of steel must be bedded in the grout, and then the cost becomes almost prohibitive. With fewer rods only part of the original strength is obtained. The concrete being entirely enclosed, it takes a very long time for it to set; in the meantime, if the pole is badly corroded, and as the corrosion is all the time going on and increasing on the outside, the pole is liable to bend or collapse; further, the swaying and vibration of the pole is liable to loosen the bond between concrete and the metal, and therefore the strength to be greatly decreased. It has been found out from actual experience that in the winter time, when the metal of the pole contracts, the inside plug of concrete does not permit of such a shrinkage, and the pole splits. There are known instances in which such poles split the entire length. The pole itself continues to corrode on the outside, and in course of time some other method must be applied on the outside to eliminate the trouble.




**Power Distribution—Fig. 1.—Cost of Re-Leading Cable According to Cost of New Cable Less Scrap.**

The second method would appear to be quite effective on wooden poles, but it has not been tried a sufficient length of time to prove its efficiency. It would appear that the concrete surrounding the pole must shrink away from the wood, thus permitting water to percolate and a further rotting of the portion repaired.

The third named is quite costly, as the clamps have to be very heavy to be efficient, and even then, being held by bolts, the latter in time may become loose and corroded, and it requires constant inspection and maintenance. At best it is only temporary. It also does not stop the further corrosion of the weak spots.

The fourth method from every standpoint seems to be the most efficient. It is applied at the spot where the trouble originates, and entirely eliminates further corrosion or rotting. It is permanent in its nature. It brings the pole to its original strength, and, as a matter of fact, poles that have been tested with such sleeves have stood a greater stress than new ones. It looks well and neat in the street. And finally, its cost is the lowest. This method is especially efficient when the filling material is introduced in a molten state, e.g., molten brimstone. In making this repair, some sleeves have been filled with grout, but this method is not recommended by the committee.

(To be Continued.)

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96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto. Meet last Thursday of the month.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University

OTTAWA BRANCH—
Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Resident Engineer's Office, Department of Public Works.

**MUNICIPAL ASSOCIATIONS.**

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, Kings Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

**CANADIAN TECHNICAL SOCIETIES.**

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, C. A. Jefferis; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. E. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que.; Hon. Secretary, Alcide Chausse, 5 Beaver Hall Square, Montreal, Que.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

**AMERICAN TECHNICAL SOCIETIES.**

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders' Bank Building.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS.—President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Dec. 11 | | STOCK QUOTATIONS — TORONTO | | | | STOCK QUOTATIONS — MONTREAL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Dec. 17 '08 | Price Dec. 9 '09 | Price Dec. 16 '09 | Sales Week End'g Dec. 16 | Price Dec. 17 '08 | Price Dec. 9 '09 | Price Dec. 16 '09 | Week End'g Dec. 16 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,746,000 | 1,523,000 | 175 | 181 | 180½ | 179 | 485 | 176 | 175½ | 181½ | 180½ | 180½ | 2607 |
| Canadian Northern Railway | 3,180 | | | | | | | | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 779,135 | 731,257 | | | *1st. pref. 103½, 3rd pref. 60½, ordinary 20½ | | | | | | | | |
| T. & N. O | 334 | (Gov. Road) | | 31,597 | 17,950 | | | | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 73,989 | 67,189 | | | | | 203½ | 224½ | 215 | 214½ | 215½ | 214½ | 652 |
| Toronto Street Railway | 114 | 8,000 | 100 | 77,795 | 70,271 | 106½ | 106½ | 125½ | 125½ | 127 | 812 | 106 | 105½ | 126 | 125½ | 126½ | 126½ | 2000 |
| Winnipeg Electric | 70 | 6,000 | 100 | | | 167½ | 166 | 185 | | 185 | | | 165 | | | 185 | | |

* G.T.R. Stock is not listed on Canadian Exchanges. These prices are quoted on the London Stock Exchange.

## HALIFAX ELECTRIC TRAMWAY EARNINGS.

Halifax Electric Tramway earnings for week ended December 14th were:—

| | |
|---|---|
| 1909 | $3,436.29 |
| 1908 | 3,249.10 |
| Increase | $187.19 |

And for week ended December 17th:—

| | |
|---|---|
| 1909 | $3,464.63 |
| 1908 | 3,151.30 |
| Increase | $313.33 |

Mileage operated, 13.3 miles.

Montreal Street Railway for the two months of its new fiscal year is making a very good showing. Net earnings show a gain of $29,925, or 10½ per cent. over last year.

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto & York Radial Railway.
Windsor, Essex & Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.
Niagara, St. Catharines and Toronto Railway.
Peterborough Radial Railway.

## BERLIN AND WATERLOO RAILWAY.

Commission, A. L. Breithaupt, chairman.
Purchasing Agent, V. S. McIntyre, secretary-treasurer.
**Kind of Road:** Single track street railway, 3½ miles long.
Type of cars: Closed, 40.
Number of motors, 4.
Power of motors, 35 horse-power.
Method of braking, air.
Gauge of track, 4 ft. 8½ in.
Weight of rails, 56-72 lbs.
**Power:**
Direct current, 500-550 v.
Alternating current.
Voltage of transmission.
Trolley voltage, 550 v.

## NEW INCORPORATIONS.

**Quebec.**

The Fassett Lumber Company, Limited, Fassett, Que., $1,000,000; lumbering. Louis Boyer, advocate, Montreal, is an incorporator.

**Ontario.**

The Temiskaming and Gow Ganda Transport Company, Ltd., of Toronto, capital $40,000; provisional directors, G. H. Gauthier, J. D. McMurrich, T. G. Ferriss, V. E. Taplin, S. Willows, W. Jamieson, J. Harris, and J. S. McLean.

Thomas Meredith & Company, Ltd., Toronto, hardware, capital $40,000; provisional directors, Thomas Meredith, Richard Meredith, and Austin Meredith.

The Essex Light and Power Company, Ltd., of Essex, capital $30,000.

R. Bigley Manufacturing Company, Ltd., Toronto, capital $100,000, stove founders; provisional directors, A. E. Randall, G. M. Mulholland, A. Todd, R. Bigley and J. H. Young.

American Road Machine Company of Canada, Ltd., Goderich, capital $100,000.

The Smith & Travers Diamond Drill Company, Ltd., Sudbury, capital $100,000.

The Canada Refining and Smelting Company, Ltd., Toronto, capital $40,000; provisional directors, A. E. Stevens, of Providence, R.I., E. H. Fairbrother, H. E. Smith, H. T. Smith, and W. J. Elliott.

McLean Temagami Mining Company, Ltd., of Ottawa, capital $1,000,000.

Boston & Ontario Silver Mines Company, Ltd., Toronto, capital $40,000; provisional directors, R. Credicott, W. Gilchrist, C. Y. Spearing, J. Stewart, and G. E. Hancock.

Porcupine Lake Gold Mines, Ltd., Toronto, capital $1,000,000; provisional directors, H. J. Lewis, J. S. McCullough and James Linton.

Wellington Mines, Ltd., Guelph, capital $750,000.

Dominion Limestone Company, Ltd., Port Colborne, capital $50,000.

The Caledonian Gypsum Company, Ltd., Hamilton, capital $150,000.

Cedar Lake Cobalt and Silver Mines, Ltd., Toronto, capital $1,000,000; provisional directors, A. W. Holmested, A. L. Ross, D. L. Brebner, A. R. Bickerstaff, F. H. Potts, W. L. Carr and E. M. Carruthers.

Union Creek Mining Milling Company, Ltd., Peterborough, capital $100,000.

**British Columbia.**

The following new companies have been incorporated in British Columbia:

Mission Water, Light & Power Company, Ltd., capital $50,000; to take over the water rights and records of H. Windebank, and to supply the city of Mission with water, etc.

The Buccaneer Bay Mining & Development Company, Ltd. (non-personal liability); capital $500,000; to purchase from the Hunter Syndicate the mineral claims Golden Eagle and Little Wonder, situate in Buccaneer Bay, and on Thormanby Island, and held by the Hunter Syndicate in the names of James A. Muir and James L. Lougheed, and to pay therefor the sum of four hundred thousand shares of the capital stock of the company at par.

The Surrey Nurseries, Ltd.; capital $25,000.

The Sheep Creek Bonanza Mining Company, Ltd., capital $500,000; general mining.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Ontario**

FORT WILLIAM.—Tenders for Post Office Fittings will be received until December 30, 1909. Mr. W. T. Rankin, Clerk of Works, Fort William. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received up to January 5th for six hundred and twenty-four tons of steel plates and shapes required at the Government Shipyard at Sorel, P.Q., delivered free. Specifications and detailed information can be obtained from the Purchasing Agent of the Department of Marine and Fisheries, Ottawa, and from the Director of Shipyard, Sorel, P.Q. G. J. Desbarats, Deputy Minister of Marine and Fisheries, Ottawa.

STRATFORD.—Until Saturday, January 15th, the city of Stratford wants tenders for two electrically-driven turbine pumps of one million and one and a half million gallons capacity. They should be addressed to Mr. J. Davis Barnett, chairman, water commissioners. Mellis Ferguson is city engineer.

TORONTO.—Tenders will be received until Thursday, December 23rd for plumbing, ventilating and metal ceiling work, required in lavatory, Central Building, Department of Education, Toronto. Mr. H. F. McNaughten, secretary Public Works Department.

WHITBY.—Tenders for interior, fittings, Post Office, Whitby, will be received until January 7th. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

**Manitoba**

WINNIPEG.—Tenders will be received up to Tuesday, January 18, for removing the present superstructure and furnishing and erecting new steel superstructure and floor, complete, for Louise Bridge across the Red River. Plans, specification and forms of tender may be obtained at the office of Colonel Ruttan, the city engineer. M. Peterson, secretary Board of Control.

**Alberta.**

MEDICINE HAT.—Tenders will be received until Tuesday, January 4th, for clay products plant, including three high-pressure boilers, 120 horse-power Corliss engine, generator and engine, pumps, pans, elevator, pulley, belting, sewer pipe press, structural steel, 4 horse-power gas engine, four side-dump cars, gap lathe, iron planer, forge and blacksmith tools, 500 horse-power heater and fire hose. Address communications to Warren Overpack, 404 N. Des Moines Street, Webster City, Iowa.

**British Columbia**

NORTH VANCOUVER.—Tenders will be invited for the construction of a new ferry boat by the North Vancouver Ferry Company which is owned by the city.

**U. S. A.**

DETRIOT, MICH.—Tenders for furnishing and erecting machinery for a Sewage Pumping Station to be located at the foot of Park View Avenue, Detroit, will be received until the 5th January, 1910. Proposals shall include two centrifugal pumps, capacity 100 cubic feet per second, one centrifugal pump capacity 30 cubic feet per second, engines, motors, boilers and other machinery and apparatus necessary for a complete installation. Jacob J. Haarer, Commissioner.

GUAYAMA, PORTO RICO.—Tenders will be received until January 17th, 1910, for the construction of an earth and gravel dam, to be known as the Patillas Dam and Appurtenant Structures near the town of Patillas, Porto Rico, requiring the excavation of about 726,000 cubic meters of earth, rock and gravel, and the placing of about 2,000 cubic meters of concrete. The estimated cost is about $500,000. Plans and specifications may be obtained from the Commissioner of the Interior, San Juan, Porto Rico, from the U. S. Reclamation Service, Washington, D. C. A deposit of $2.00 is required for the plans, which will be refunded on the return of plans prior to the date set for opening bids. B. M. Hall, Chief Engineer, Porto Rico Irrigation Service. At a later date invitations will be issued for proposals, to be opened at the same time and place on the construction of about 6,000 feet of rock tunneling in connection with this project. Opportunities will be afforded, at future dates, of bidding on the construction of additional dams and canals, estimated to cost abut $1,200,000.

## CONTRACTS AWARDED.

**Quebec**

HULL.—City Engineer R. W. Farley, recommended for consideration the following tenders for the construction and erection of duplex and triplex power pumps, capacity six million United States gallons per day, likewise turbine wheels for operation of same:

Canada Foundry Company, Toronto, $18,000.
John Inglis Company, Toronto, $17,350.
Wm. Hamilton Company, Peterboro, Ont., $14,500.

The contract has not yet been awarded.

MONTREAL.—William Duquette was awarded a contract by the town of St. Louis who received the following tenders for the construction of a subway under the C.P.R tracks:—W. Duquette, $80,000; Henault & Hefferman, $120,000; the Clinton Company, $187,467. Mentioned in last week's issue.

**Ontario.**

DUNNVILLE.—Tenders were recently invited for constructing about 18,000 feet of tile sewers, the contractor to furnish all materials. Contract was awarded to the Excelsior Constructing and Paving Company, Limited, of Toronto, at $15,073. Following were the bids received: — $18,186, $24,284, $22,067, $21,083, $20,501, $25,493, $25,327, $15,073, $23,643, $27,862, $21,140. Mr. Willis Chipman, of Toronto, is chief engineer.

HAMILTON.—Contracts for motors and pumps for the Beach pumping plant and the east end Annex sewage disposal works were awarded as follows:—Canadian Westinghouse Company two motors and two transformers for the beach pumping plant, at $16,626, and with the J. McDougall Caledonian Iron Works Company, Montreal, two 6,000,000 gallon pumps $7,220. Westinghouse Company two 3,000,000 gallon pumps for the east end annex sewage disposal works, two small motors and one small transformer for lighting purposes, at $4,065.

LATCHFORD.—The contract for the construction of the Dam and Sluiceways at Latchford has been awarded to Messrs. W. H. Sinclair and D. B. Campbell of West Toronto, Ontario.

TORONTO.—The Factory Products Company have been awarded contracts for the following supplies in connection with the municipal electrical distribution plant: — 30-foot poles, @ $2.35 each; 35-foot poles, @ $3.90 each; 40-foot, @ $5.25 each; 45-foot @ $6.50 each; 50-foot, @ $9 each; 65-foot, $11 each; crossarms, $2,462; braces, $2,527; guy wire, $347. The Northern Electric & Manufacturing Company were given a contract for machine bolts at $1,493, while an order was placed with Brazil & Company for 45-foot poles at $6.50, 50-foot poles @ $9, and 60-foot poles @ $14.

TORONTO.—The tenders for roofing have been closed by the National Iron Works in favor of Factory Products, Limited, for asbestos roofing, manufactured by the Canadian H. W. Johns Manville Company, Limited.

TORONTO.—Tenders were received as follows for two steam fire engines for the fire department, each to be of 800 American gallons capacity:—

Waterous Engine Works Co., Brantford, Ont., $10,500.
Canadian Fire Engine Company, London, Ont., $10,280.
American LaFrance Fire Engine Co., Elmira,
New York ..... $11,600.

The contract was awarded to the Waterous Engine Works Company. (Mentioned in last week's issue.)

TORONTO.—For annual supplies, the following tenders were received by the City of Toronto:—

SEWER PIPE; (2 foot lengths)—The Dominion Sewer Pipe Company, of Swansea, Ontario, were awarded the contract at the following prices per foot: for 4 inch, 5 cents; 6-inch, 6 1-5 cents; 9-inch, 13 4/5; 12-inch, 23 cents; 15-inch, 30 cents; 18-inch, 39c.; 24-inch, 81 cents; for 1 foot lengths: 6-inch, 8c. per foot; 9-inch, 17c. per foot. Other tenders were:—For 2 ft. lengths, per foot—4-inch, 6c.; 6 inch, 10c.; 9-inch, 21c.; 12-inch, 35c.; 15-inch, 47½c.; 18-inch, 59½c.; 24-inch, $1.13¾; for one-foot lengths: 6-inch, 10c.; 9-inch, 21c.

CURVES, ELBOWS AND BENDS:—

| 6-in., ¼, each. | 6-in., ⅜, each. | 9-in., ¼, each. | 9-in., ⅜, each. | 12-in., ¼, each. | 12-in., ⅜, each. |
|---|---|---|---|---|---|
| cts. | cts. | cts. | cts. | $ c. | $ c. |
| *27½ | *27½ | *60 | *60 | *1 00 | *1 00 |
| 38½ | 38½ | 84 | 84 | 1 40 | 1 40 |

*Prices of Dominion Sewer Pipe Company, who received contract.

LUMBER—Pine lumber, hemlock lumber.

| 1-in., per 1,000 ft. | 2-in., per 1,000 ft. | 3-in., per 1,000 ft. | 1-in., per 1,000 ft. | 2-in., per 1,000 | 3-in., per 1,000 ft. |
|---|---|---|---|---|---|
| $ | $ | $ | $ | $ | $ |
| 23 37 | 22 37 | 25 37 | 18 37 | 18 37 | 20 37 |
| 22 69 | 22 07 | 26 73 | 21 97 | 21 97 | 22 97 |

Contracts for lumber were given to Reid & Company, and the Gall Lumber Company, for lowest price in each instance.

LEAD PIPE.—Per 100 lbs.

| ⅜-inch. | ½-inch. | ⅝-inch. | ¾-inch. | 1-inch. |
|---|---|---|---|---|
| $ c. | $ c. | $ c. | $ c. | $ c. |
| 5 29 | 5 29 | 5 29 | 5 29 | 5 29 |
| 5 35 | 5 35 | 5 35 | 5 35 | 5 35 |

Contract awarded to the James Robertson Company, at $5.29.

BRASS AND BRONZE CASTINGS.—Per lb.

| Phosphor Bronze. | Tobin Bronze. | Brass Castings. | Babbitt, A 1 quality. |
|---|---|---|---|
| cts. | cts. | cts. | cts. |
| 18½ | 20 | 18 | 8 |
| 19 | 25 | 18¼ | 12½ |
| 20 | .. | 18 | .. |

Contract awarded to No. 1, the Canada Metal Company.

CAST IRON PIPE—12-inch—Awarded to Canada Foundry Company, Toronto, at $16.75 a length.

LIMESTONE DUST: f.o.b. cars, C. P. Railway, per ton, $4.90, $5.55, $5.40—awarded to Eureka Dust Company, @ $4.90.

HYDRANTS, &c.:—

| | No. 1. | No. 2. |
|---|---|---|
| 3 way hydrants ..... | $44.90 | $42.00 |
| 2 " " ..... | 42.20 | 39.70 |
| Frost jackets (additional) | 5.80 | 8.00 |
| 3-foot pipes (additional).. | 7.00 | 10.00 |

Contracts awarded as follows: Hydrants, Canada Foundry Company (No. 2); additional frost jackets and additional 3-ft. pipes, Canada Steam Pump and Machine Company (No. 1).

SPECIAL CASTINGS.—$2.35, $2.10, $2 per 100 lbs., to Reid & Brown, of Toronto, at $2.

PORTLAND CEMENT:—

| Brand | In Barrels Per 350 lbs. net. | In Sacks Per 350 lbs. net. |
|---|---|---|
| | $ c. | $ c. |
| Star or Lehigh ..... | *1 98 | *1 98 |
| Superior ..... | ..... | 1 62½ |
| National, etc. ..... | .... | 1 57 |
| Maple Leaf ..... | ..... | 1 75 |
| City Engineer ..... | ..... | 1 70 |

*Including 4 sacks at 10c. each; this amount allowed for all sacks returned.

Tender No. 3, from the National Portland Cement Co., of Durham, Ontario, at $1.57 per 350 lbs. net was accepted.

SEWER BRICKS. Per 1,000.

| East of Don. | Between Don and Bathurst St. | West of Bathurst St. |
|---|---|---|
| $ c. | $ c. | $ c. |
| 10 50 | 10 00 | 12 60 |
| 10 25 | 9 50 | 9 50 |

The contract for the entire supply of sewer bricks was awarded to the Port Credit Brick Co. (tender 2), being the lowest throughout.

SAND FOR ASPHALT PURPOSES.—Per cubic yard, 95 cents, 95 cents, 85 cents, *40 cents, $1.00.

*Foot of Spadina Avenue loaded in waggons.

The contract was awarded to the Sand & Dredging, Limited, at 85 cents.

ROUGH RUBBLE STONE.—F.O.B. Cars, G. T. Railway, per ton $1.10. Awarded to Britnell & Company, Ltd.

**Manitoba.**

WINNIPEG.—The Norcross Company, of New York, have been awarded the contract for the Bank of Montreal building, Winnipeg. The same company built the main body of the Montreal building, and have done extensive work in other cities for the bank. They were the lowest tenderers. The contract price will involve an expenditure of about $1,250,000.

WINNIPEG.—The Stuart Machinery Company of Winnipeg have just supplied two large boilers to J. D. McArthur for his 12-story office building. These large internal furnace boilers are 250 h.p., and weigh 45,000 pounds each. They are 9 feet, 6 inches in diameter and 16 feet, 4 inches long. The shell is 7/8ths of an inch thick and the boilers are tested to 240 pounds pressure.

**Alberta**

CALGARY.—The commissioners have opened the tenders for the six new street cars and again find the Ottawa and Preson Car companies the lowest. The tenders were as follows:—

| | Preston Car Co. | Ottawa Car Co. |
|---|---|---|
| Bodies ..... | $2,175 | $2,396 |
| Trucks ..... | 763 | 749 |
| Air brakes ..... | 522 | 540 |
| Scrapers ..... | 30 | 28 |
| Fenders ..... | 52 | 49 |

**U. S. A.**

ALBANY, N. Y.—The itemized bids received by F. C. Stevens, Superintendent Public Works, for Contract No. 54, for constructing Lock No. 7 at Fort Edward; Contract No. 69, for constructing in the Hudson River Lock No. 2 below Mechanicville, together with all appertaining construction; Contract No. 72, for dredging a channel in the Hudson River and performing work incident thereto from Lock No. 2 to Lock No. 4, a distance of 4.1 miles; and Contract No. 2E, for completing the construction of the canal from the Mohawk River at Waterford to a point about one-fourth of a mile above the head of Lock No. 3, were as follows: Contract No. 54—(A) Engineer's estimate; (B) Scott Bros., Baldwinsville, N. Y., who were the only bidders. (Awarded contract.)

| | (A) | (B) |
|---|---|---|
| 45,600 cu. yds. excavation ..... | $0.30 | $0.36 |
| 2 M. ft. B. M. sheeting and bracing, per M. ft..... | 50.00 | 50.00 |
| 11,300 cu. yds. forming embankment.. | .15 | .18 |
| 1.1 M. ft. B. M. sawed lumber (yellow pine or Douglas fir, per M. ft. ..... | 50.00 | 55.00 |
| 16 M. ft B. M. sawed lumber in needles, per M. ft. ..... | 100.00 | 100.00 |
| 6.8 M. ft. B. M. white oak lumber in miter sills, lock gates and buffer blocks, per M. ft. | 100.00 | 120.00 |
| 60,600 lin. ft. foundation piles, 16 to 30 ft. long ..... | .25 | .25 |
| 130 lin. ft. mooring piles, 20 ft. long | .30 | .32 |
| 225 M. ft. B M. wooden sheet piling, per M. ft. ..... | 50.00 | 50.00 |
| 21,700 cu. yds. second-class concrete.. | 6.00 | 6.40 |
| 600 cu. yds. wash wall ..... | 2.50 | 2.50 |
| 240 cu. yds. second-class rip-rap... | 2.75 | 2.75 |
| 3,660 cu. yds. third-class rip-rap..... | 2.50 | 2.50 |
| 7,200 lbs. structural steel ..... | .045 | .05 |
| 376,000 lbs. metal reinforcement ..... | .035 | .0375 |

| | | | |
|---|---|---|---|
| 9,800 lbs. | steel castings | .045 | .05 |
| 7,300 lbs. | iron castings, machined | .08 | .08 |
| 250 lin. ft. | wrought iron pipe, 3 ft. diam. | .40 | .40 |
| 480 lin. ft. | wrought iron pipe railing | 1.00 | 1.10 |
| 200,000 lbs. | metal in lock gates | .05 | .055 |
| 92,000 lbs. | metal in buffer beams | .055 | .06 |
| 25,000 lbs. | metal in lock valves | .08 | .09 |
| | Coffer-damps, pumping, bailing and draining (lump sum) | 15,000.00 | 18,000.00 |
| | Totals | $232,908 | $250,590 |

## RAILWAYS—STEAM AND ELECTRIC.

**Ontario**

LONDON.—The formal transfer of the Southwestern Traction line to the recent purchasers was made last week. The following committee of directors are to manage the line: Messrs. Murray N. Verner of Pittsburg and Brantford, W. S. Dinnick, W. K. George, George B. Wood, S. C. Smoke, Toronto; T. H. Purdom, K.C., and John Milne, London. The former manager, Mr. S. B. Mower, is retained in the same position. It is stated that $150,000 will be spent in correcting grades, improving curves, and purchasing new cars.

OTTAWA.—The Minister of Railways, has given his approval to the following general route maps in the West:—C. P. R. Alderside branch. G. T. P. from Apollon main line west of Pembina river, crossing southwesterly towards the headwater of Little Pembina River, Alberta. Pacific Northern and Omineoa railway, from Edmonton northwesterly to the boundary between Alberta and British Columbia. Canadian Northern railway, revision of route of Oak Point extension, Manitoba. G. T. P. amended general location between Edmonton and Prince Rupert. C. P. R. Sedgwick and Ellerslie branch. C. N. R. Crooked Lake branch.

WINDSOR.—The Sandwich, Windsor & Amherstburg Railway will probably place contracts in a few days for two 500 k.w. three-phase, direct connected alternators and two 750 h.p. engines. James Anderson, general manager.

**Alberta**

EDMONTON.—The Grand Trunk Pacific bridge over the Pembina river will be completed by December 20th, in readiness for the laying of the steel. The bridge which is being erected by the Canadian Bridge Works, of Walkerville, is practically completed this week and there remains only the finishing touches before it will be possible for trains to cross. The track laying machine, which has been working on the Melville branch, will be put to work at once laying steel from the Pembina to the McLeod river, where two other larger bridges are in course of erection.

**British Columbia.**

NEW WESTMINSTER.—The British Columbia Electric Railway will open their Fraser River Valley Line as far as Cloverdale about December 20th. The distance is about 12 miles.

VANCOUVER.—The British Columbia Electric Railway Company are considering the expenditure of $200,000 for cars, locomotives, etc., early next year, according to general manager Sperling.

VICTORIA.—Wade, Whealler & McQuarrie give notice in the British Columbia Gazette of intention to apply for incorporation for a company with power to build, and operate a railway, commencing at Port Moody, for 20 miles. Davis, Marshall & Macneill ask for the same power for a company regarding a proposed line commencing near where the Salmon river crosses the international boundary line, between British Columbia and Alaska; thence following the Salmon River to its source.

## LIGHT, HEAT, AND POWER

**Ontario.**

BELLEVILLE.—On January 7th the ratepayers will vote on a by-law to authorize an agreement between the Trenton Electric and Water Company, Ltd., and the corporation of Belleville.

**Alberta**

CALGARY.—On Saturday, December 18, tenders closed with Smith, Kerry & Chace, consulting engineers, for the erection of a sub-station at Horse Shoe Falls, for the Calgary Power and Transmission Company.

## FINANCING PUBLIC WORKS.

The following municipalities recently sold debentures:—

**Cardston, Alta.**—$5,440, local improvements.
**Osgoode Township, Ont.**—$7,456, drainage.
**Roxborough Township, Ont.**—$11,681, drainage.
**Dover Township, Ont.**—$11,026, drainage.
**Strathroy, Ont.**—$20,000, sidewalks.
**Midland, Ont.**—$12,000, sidewalks and sewers.

**Ontario**

WALLACEBURG.—The ratepayers will vote on two by-laws in January, one to borrow $20,000 for the erection of a new public school and the other for local improvements, such as granolithic walks.

LONDON.—The ratepayers will vote on a $60,000 sewerage by-law.

BRACEBRIDGE.—Tenders for $45,000 electric light plant debentures are invited until December 21st. Alex. C. Salmon, Treasurer.

**Manitoba**

STE. ANNE.—The ratepayers will vote on a by-law to issue $20,000 debentures for roads and bridges. J. A. Lacerte is secretary-treasurer.

**Saskatchewan**

BATTLEFORD.—A by-law to provide $5,000 for an electric light pole line extension will be voted on shortly.

## PERSONAL NOTES.

MR. McCULLOUGH, city electrical engineer of Vancouver, B.C., has resigned.

MR. D. M. DUNCAN has resigned from the position of registrar of the Manitoba University to accept the Principalship of one of the Winnipeg Collegiates.

## OBITUARY.

MR. WALLACE BELL, president of the Wallace Bell Drilling Company, of Montreal, died recently. Prior to moving to Montreal Mr. Bell had been engaged in drilling operations at Petrolea. During his career he was connected with some very important drilling contracts, one of the largest being for the sinking of a shaft to a depth of 2,600 feet for the Laprairie Brick Company.

## PATENTS.

The following is a list of Canadian patents, granted on December 7, 1909, by the Canadian Patent Office to Canadians in Canada, and furnished by Fetherstonhaugh & Company, 5 Elgin Street, Ottawa, Canada, Russel S. Smart, resident, from whom information concerning the same may be obtained:

R. Armstrong, Victoria, B.C., compressed air signals. J. Pattison, Prescott, Ont., thermo electric alarms. Redington, Cobalt, Ont., air or steam rock drills: F. C. Simson, Halifax, N.S., illuminating signs.

Below will be found the list of patents granted in Canada, furnished by Fetherstonhaugh & Company, Toronto:—

T. C. Mussen, Toronto, Ont., vehicle tires; J. Muir, Brantford, Ont., traction engines; A. Baillott, Montreal, Quebec; furnace grates; T. Clouston, Vancouver, B.C., gas producers; D. L. Davies, Montreal, Que., nut locks; N. Lang, Vancouver, B.C., railway track indicator; A. O. Lavoie, Montreal, Que., hydraulic motors; R. Maw, Montreal, Que., car-stopping devices; W. C. Mitchell, Sydney, N.S., centrifugal drying machine; W. W. Salter, Toronto, Ont., flue doors; T. G. Thorne, Vancouver, B.C., wrenches; C. W. Vollman, Montreal, Que., insulating compounds; J. Veno, Vancouver, B.C., screw presses.

## COMING MEETINGS.

**Canadian Society of Civil Engineers.**—Annual meeting at Ottawa, Ont., January 25th, 26th, 27th, 1910. Mr. C. H. McLeod, secretary, 413 Dorchester Street West, Montreal, Canada.

**American Society of Civil Engineers.**—January 19-20. Annual meeting at New York City. Secretary, Charles W. Hunt, 220 West 57th Street, New York City.

**Illinois Society of Engineers and Surveyors.**—January 26-28. Annual meeting, Cairo, Ill. E. R. Tratman, secretary, 1636 Monadnock Block, Chicago, Ill.

**Connecticut Society of Civil Engineers.** — February 8. Annual meeting, New Haven, Conn. J. Frederick Jackson, secretary, Box 1304, New Haven, Conn.

**American Society of Engineering Contractors.**—February 24-26. Annual convention, Chicago, Ill. Daniel J. Hauer, secretary, Park Row Building, New York, N.Y.

## SOCIETY NOTES.

**Engineers' Club, Toronto.**—The officers for 1910 were elected at the annual meeting of the Engineers' Club last Thursday evening as follows: Hon. President, Professor Galbraith, School of Practical Science; president, Mr. Willis Chipman, 103 Bay Street; first vice-president, Mr. C. M. Caniff; second vice-president, Professor R. W. Angus; chairman library committee, Mr. W. Almon Hare; chairman rooms committee, Mr. W. V. Reynolds; chairman papers committee, Mr. C. R. Young, B.A.Sc.; treasurer, Mr. L. J. Street, 37 Melinda Street; secretary, Mr. R. B. Wolsey, 25 Lowther Avenue.

**Engineering Society, Queen's.**—The Engineering Society of Queen's University, Kingston, held their thirteenth annual dinner on December 15th, 1909. The attendance was large, the speeches bright and the guest list representative. After the toast to the King had been received Principal Gordon proposed Our Country. He reviewed briefly the history of Canada, pointing out that in overcoming natural, political and social difficulties Canadians had developed a strong national life.

Mr. M. J. Butler, Deputy Minister of Public Works, Ottawa, was the first to reply. Mr. Butler referred to the place of the engineer in nation building and referred to transportation as the present great Canadian problem.

Colonel Crowe, commandant of the Royal Miltiary College, Kingston, also replied and outlined the engineers place in defence. The name of W. R. Givens, B.A., editor of the Standard was also coupled with this toast. To his mind Canada's present task was a task of assimilation. A correct solution of our labour problems was our salvation.

The University was proposed by Mr. Charles Macdonald, B.A., past president of the American Society of Civil Engineers, and replied to by Dr. Jordan of Queen's.

In proposing the Profession, Mr. L. W. Gill referred to the desirability of engineers taking a more prominent place in the social and political life of a country. He also thought the engineer should enter the field of management in industrial corporations.

In reply R. W. Brock, Director Geological Survey of Canada; H. E. T. Haultain, Professor of Mining, Toronto University; C. H. O. Pook, Canadian Westinghouse, Hamilton, Ont., and R. H. Seely, Hamilton, Ont.

The Faculty were proposed by Mr. A. M. Bateman, and responded to by Dr. Goodwin and Professor MacPhail. Sister Institutions were proposed by Mr. K. S. Clarke, and replied to by Mr. W. J. Walker for the Students in Engineering Toronto and representatives of McGill and R.M.C.

**Canadian Society of Civil Engineers, Montreal.**—A very interesting meeting of the Canadian Society of Civil Engineers was held last Thursday night in their assembly rooms on Dorchester Street, Montreal. Mr. A. D. Swan, M. Can. Soc. C.E., resident engineer of the harbour of Montreal, delivered a paper on the new King Edward Docks at Avonmouth, Bristol, where he was resident engineer on construction. The lecture, which was fully illustrated by lantern slides, provided those present with an excellent idea of the vastness of the undertaking. Mr. Swan stated that a large area of land had been reclaimed and was now being used for railway terminals and industrial purposes. The first work undertaken was that of sinking trial cylinders to ascertain the nature and extent of the excavations necessary. The lecturer pointed out the great variation in tide levels, and how this natural difficulty was overcome by the construction of temporary dams. He explained the process of rock breaking under water, without explosives, and described the main features in connection with the construction of the west dock walls of the entrance piers and the concrete monolith structures, of the pier head monoliths, entrance locks, graving dock with its elaborate system of culverts and sluices, light houses, railway terminals, lock-gates of iron and steel, which are the largest in the world, and the mechanism known as the boom relieving chain protection for lock gates, which prevents ships from running into and destroying the gates. After the lecturer had dealt with the constructive principles of this great work, he described the equipment of the dock, and finished his discourse with a reference to the materials used in construction, and the relative merits of each. He said that the cost of the entire undertaking was about $15,000,000, and this, he maintained, was about one-half of what the work would have cost in America. The opening ceremony was performed by Their Majesties, King Edward and Queen Alexandra. After the lecture, a discussion followed, in which Mr. John Kennedy, Mr. F. W. Cowie, and Mr. J. A. Jamieson took part, the latter taking an opposite view to the speaker, regarding the possible cost of such a work in Canada. Mr. Cowie referred in complimentary terms to the work of the speaker in his capacity of resident engineer of the works at Avonmouth. Mr. John Kennedy, consulting engineer of the Montreal Harbour Board, explained why, in a new country like Canada, it was not advisable to build too much of a permanent character, on account of the changing avenues of trade, and the generally unsettled state of the country. At the conclusion of the meeting a hearty vote of thanks was tendered Mr. Swan by the chairman, Mr. Ernest Marceau, and it was decided to continue the discussion by correspondence, to be incorporated in the reports of the society.

**Builders' Exchange, Winnipeg.**—The annual meeting of the Winnipeg Builders' Exchange was held Wednesday and besides the election of officers for the ensuing year, matters of future policy were discussed. It has been decided to secure a central site and erect a fine structure to be known as the Builders' Exchange Building. The meeting was largely attended, and there was great enthusiasm. William H. Carter, of the Carter, Halls, Aldinger Company, was re-elected president, the meeting complimenting him highly on his work during the last year. It was pointed out that when he took office in December 1908 the exchange had only 100 members, and that now its membership was 303. F. H. Davidson was elected first vice-president. Thomas Kelly, of Thomas Kelly & Sons, was elected second vice-president, T. D. Robinson, treasurer, and J. H. Buxton was reappointed secretary. The following directors were re-elected by acclamation for a three-year term: W. P. Alsip, J. W. Morley, H. C. McMartin, Charles S. Shipman.

**Guild of Civic Art, Toronto.**—At the annual meeting, held in Toronto, December 21st, 1909, the following officers were elected for the ensuing year: President, Mr. John A. Ewan; first vice-president, Mr. K. J. Dunstan; second vice-president, Mr. C. H. Mitchell; executive committee, Messrs. H. C. Cox, J. P. Hynes, T. C. Irving, junr., Ford Howland, F. B. Fetherstonhaugh, J. B. O'Brien, Edmund Burke; treasurer, R. J. Dilworth, and secretary, W. S. Armstrong.

**Central Railway and Engineering Club, Toronto.**—The regular monthly meeting of the Central Railway and Engineering Club of Canada was held at the Prince George Hotel, Toronto, last Tuesday night. The business of the evening consisted of an address on "The Manufacture of Commercial Gas," by Mr. C. J. Herring, chief draftsman, Consumers' Gas Company, and the election of officers for the ensuing year. Mr. C. A. Jefferis, the retiring president, occupied the chair. About fifty members attended. The following were elected officers: President, Mr. J. Duguid, general foreman G.T.R.; first vice-president, Mr. G. Baldwin, general yardmaster Canada Foundry Company; second vice-president, Mr. J. Bannon, chief engineer, City Hall, all of Toronto; executive committee, Messrs. C. A. Jefferis, master mechanic Consumers' Gas Company; W. R. McRae, master mechanic Toronto Railway; O. A. Cole, A. M. Wickens, chief engineer Canadian Casualty and Boiler Insurance Company; A. E. Till and A. Taylor of Toronto, and Mr. Patterson of Stratford.

## ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8819—December 3—Extending until the 1st of June, 1910, the time within which the Canadian and Dominion Express Companies may file tariffs of tolls to be charged for the carriage of goods are temporarily approved.

8820—December 2—Dismissing complaint of Wagstaff, Limited, of Hamilton, Ontario, that the rate of $1.20 per hundred pounds charged by the Dominion Express Company on shipments of black currants from Montreal to Hamilton is excessive and discriminative as compared with the rate of eighty cents per 100 lbs. charged on like shipments from Hamilton to Montreal.

8821—December 3—Extending until the 1st of June, 1910, the time within which the National and American Express Companies may file tariffs of tolls to be charged for the carriage of goods, are temporarily approved.

8822—December 3—Extending until 1st June, 1910, the time within which the Maritime Express Company may file tariffs of tolls to be charged for the carriage of goods, with the Board.

8823—December 4th—Authorizing the C.P.R. to open for the carriage of traffic the second track of the Ontario and Quebec Railway, Smith's Falls Section, from Vaudreuil to St. Lazare, also from mileage 44.9, just west of Dalhousie Mills, to mileage 48.6; and from mileage 48.8 to Avonmore.

8824—December 2—Extending until 1st June, 1910, the time within which the United States and the Great Northern Express Companies may file with the Board tariffs of tolls to be charged for the carriage of goods.

8825 and 8826—December 2—Authorizing the corporation of the city of Hamilton, Ont., to lay sewer under the track of the Hamilton Radial Electric Railway at Lot 7, First Concession Township of Barton, County Wentworth, Hamilton, Ont., also under the track of the Toronto, Hamilton and Buffalo Railway at Lot 8, First Concession Township of Barton, County Wentworth, Hamilton, Ont.

8827—December 6—Authorizing the G.T.P. Railway to cross, at grade, Pheasant Hills Branch of the C.P.R. in Sec. 13, Tp. 21, R. 12, west of the 2nd Mer., Balcarres, District Assiniboia, Sask.

8828—December 4—Authorizing the C.P.R. to construct, maintain, and operate spur line to serve the Continental Oil Company and the Canadian Petrified Brick & Stone Company at Winnipeg, Man.

8829—December 6—Authorizing the corporation of the city of Hamilton, Ont., to lay and thereafter maintain sewer under the track of the Northern and North Western Division of the G.T.R. on Lot 7, 1st Con. Tp. of Barton, County Wentworth, Hamilton, Ont.

8830—December 4—Granting leave to the Manitoba Goverament Telephones to erect, place and maintain its telephone wires across the track of the C.N.R. at public crossing near Bethany, Man.

8831 and 8832—December 4—Granting leave to the North Huron Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at private crossing on farm of T. M. Henderson, 1st Con. Tp. of Morris near Wingham Station, Ont., (half mile east), and at public crossing 1¾ miles east of Wingham Station, Ont.

8833 to 8837 Inc.—December 4—Granting leave to the Board of Light and Heat Commissioners of Guelph, Ont., to erect, place, and maintain its wires across the C.P.R. at three points and the G.T.R. at two points in the city of Guelph, Ont.

8838—December 7—Authorizing the Temiscouata Railway Company and the Transcontinental Railway to operate their trains where the Temiscouata Railway crosses the Transcontinental Railway at a point about 12.2 miles west from the town of Edmunston, N.B.

8839—November 16—Authorizing the Town of St. Louis, P.Q., to carry its highway under the track of the C.P.R. at St. Lawrence Boulevard in said town.

8840—December 4—Granting leave to the Bell Telephone Company to erect, place, and maintain its underground wires across the track of the Hamilton Radial Electric Railway about two miles east of Burlington, Ontario.

8841—December 4—Authorizing the C.P.R. to construct, maintain, and operate an industrial spur for the Riordon Paper Mills, Limited, at mileage 08.16 from St. Therese, Co. Labelle, P.Q.

8842—December 4—Authorizing the Toronto, Hamilton, & Buffalo Railway to construct, maintain, and operate two branch lines of railway or spurs in the north-east part of the city of Hamilton, Ont.

8843—December 4—Authorizing the C.P.R. to construct, maintain, and operate an industrial spur in the city of Lethbridge, Alta.

8844 and 8845 Inc.—December 7—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. near Callander Station, Ont., and near New Toronto, Ontario.

8846—December —Granting leave to the Port Hope Telephone Company to erect, place, and maintain its telephone wires across the track of the G.T.R. at Newcastle Station, Newcastle, Ont.

8847—December 6—Directing that the Toronto Suburban Railway install and maintain, at its own expense, derails in their tracks at crossing with G.T.R. at Davenport Road, Tp. of York, Toronto, Ont.

8848—December 7—Authorizing Quebec Railway, Light and Power Company to cross with its tracks, tracks of C.P.R. at St. Valier Street, Quebec, P.Q.

8849—December —Approving location of C.P.R. Company's station at Grassy Lake, Alta.

8850—December 2—Directing the G.T.R. to install distant semaphore at crossing with Galt, Preston, and Hespeler Railway Company, at rail line, Hespeler, Ont.

8851—November 24—Authorizing the corporation of city of Saskatoon, Sask., to carry Saskatchewan Drive under bridge of C.N.R., Saskatoon, Sask.

8852—December —Approving stress sheets of G.T.R. for proposed renewal of bridges near Tansley & Stewarton, Ont.

8853—December 7—Authorizing the Erie Telephone Company to place its wires across the track of the G.T.R. two miles west of Canfield, Ont.

8854—December —Authorizing the corporation of the city of Toronto, Ont., to lay sewer under C.P.R. on Huron Street.

8855—December —Authorizing the Bell Telephone Company to place its wires across the telegraph lines of the G.T.R. two miles east of Burlington Junction Station, Ont.

8856—December 6—Authorizing the G.T.R. to construct proposed bridge over Ham's Creek, near Ernestown Station, Ont.

8857—December 3—Directing the C.P.R. to provide and construct suitable highway crossing at Murrny Street, town of Sault Ste. Marie, Ont.

8858 and 8859—December 10—Authorizing the Ontario Power Co. of Niagara Falls, Ont., to erect its wires across the G.T.R. at Lot 28, in Thorold Township, Welland County, Ontario; also at Lot 29, Thorold Township, Welland County, Ontario.

8860—December 10—Directing that all railways subject to the jurisdiction of the Board where shippers are compelled to supply car doors to enable cars to be used for traffic, make allowance therefor to such shippers be made upon the following basis; (a) At and west of Fort William, lower car door, $1; upper car door, 50 cents; (b) East of Fort William, upper or lower car door, each 50 cents.

8861—December 2—Authorizing the C.N.O. Railway to carry its proposed line of railway under tracks of G.T.R. near Scarboro Junction, Ont.

8862—December 9—Approving proposed bridge of Atlantic, Quebec and Western Railway Company over Grand Pabos Gully, at mileages 41 and 40.8.

8863—December 9—Authorizing the C.P.R. to construct industrial spur for the Western Canada Timber Company at mile 29.5 north from Lardo, Kootenay District, B.C.

8864—December 9—Authorizing the C.P.R. to construct industrial spur at Gerrard Station, Kootenay District, B.C.

8865—December 10—Approving and sanctioning location of the C.P.R. Company's revision in a portion of its Kininvie Branch.

8866—December 10—Approving and sanctioning location of the C.N.O. Railway line at Greenwood, Township Pickering, Ontario County, Ontario.

8867—December 10—Directing that the P.M.R.R. erect suitable fences along its railway where the same crosses near Cedar Springs, Raleigh Township, Kent County, Ont.

8868—December 10—Authorizing the G.T.P. Railway to construct its railway across highways between Secs. 35 and 34, and 34 and 33, Tp. 52, R. 27 west 4th Mer., District of North Alberta, Alta.

8869 to 8875 Inc.—December 10—Authorizing the Manitoba Government Telephone System to erect its wires across the track of the C.P.R. at seven points in Province Manitoba.

8876 and 8877—December 10—Authorizing the Bell Telephone Company to erect its wires across the track of the G.T.R. at West and Market Streets, Brantford, and at public crossing 1¼ miles north of Whitby Station, Ont.

8878—December 11—Approving and sanctioning C.N.R. Company's location of line through Township 5, R. 7-11, west of 2nd Meridian, Sask.

8879—December 10—Directing that the trains of the C.P.R. and P.M.R.R. may operate their trains over interlocker installed at Walkerville Junction, Ont.

8880—December 10—Authorizing the C.P.R. to construct industrial spur for Messrs. Andrews & Son, Winnipeg, Man.

8881—December 10—Autborizing the C.N.O. Railway to construct bridge over Rouge River, Scarboro Township, York County, Ont.

8882—December 10—Authorizing the C.P.R. to construct branch line on its Westminster Braach, near Westminster Junction, B.C.

8883—December 9—Authorizing the C.P.R. to construct industrial spur at mileage 86 from Lethbridge, on its Crow's Nest Branch.

8884—December 11—Authorizing the Dominion Natural Gas Company, Limited, to lay gas main under track of G.T.R. at Maple Street, Simcoe, Ont.

8885—December 11—Authorizing Dr. A. L. Russell, of Bailieboro, to erect private telephone wires across track of G.T.R. at Fraserville, Ont.

8886 and 8887—December 11—Authorizing the Government of the Proviace of Alberta to erect its wires across the track of the C.P.R. at Camrose, Alta., and Sedgewick, Alta.

8888—December 11—Authorizing the Bell Telephone Company to erect its wires across the track of the G.T.R. at public crossing 2½ miles south of Harriston Station, Ont.

8889—December 13—Authorizing the C.N.R. to cross with its Goose Lake Branch the track of the G.T.P. Railway near Saskatoon, Sask.

8890—December 13—Authorizing the C.N.R. to cross with its line the track of the C.P.R. near Bienfait, Sask.

8891—November 22—Authorizing the Ontario Power Company to cross with its transmission line the track of the M.C.R.R. at Lots 174 and 175, Stamford Tp., Ont.

8892—December 11—Authorizing the C.N.O. Railway to construct bridge over Dixie Creek, Pickering Tp., Ont.

8893—December 11—Authorizing the C.N.O. Railway to construct proposed bridge over Greenwood Creek, Pickering Township, Ontario County, Ont.

8894—December 11—Authorizing the C.N.Q. Railway to construct its lines and tracks across public crossing on Lot 408, St. Marc Parish, Portneuf Co., P.Q.

8895—December 11—Authorizing the Canada Atlantic Railway to reconstruct bridge across River St. Lawrence, between Giroux Island and Isle aux Seines.

8896—October 17—Approving crossings of the C.P.R. at Blackstone Road, Moor's Road, Gough's Road, mileages 118.09; 119.67 and 120.25, and Portage Bay Road, mileage 123.21.

8897—December 11—Amending Order No. 2130, December 6th, 1906, which approved the form, size, and style of the tariffs of telephone tolls by striking out clause "a" and substituting following:—(a) That the tariffs of telephone tolls hereafter filed with the Board be printed on sheets, or in books, uniform in size, viz.:—Long distance tariffs, 10 inches in length and 7¼ inches in width; all other tariffs and rate sheets, 10½ inches in length and 8¼ inches in width.

8898—December 13—Authorizing the C.P.R. to divert Hamilton St., city of Regina, Sask.

8899—December 14—Authorizing the C.N.O. Railway to construct proposed bridge over public crossing and creek, Lot 13, Con. 3 and 4, Tp. Whitby, Ont., County Ontario.

8900—December 13—Approving plan of proposed subway at intersection of Albert St., Regina, Sask.

8901—December 14—Authorizing the corporation of the city of Brantford, Ont., to lay sewer under track of G.T.R. across West Street, Brantford, Ont.

8902—December 13—Authorizing C. S. Hyman & Company, of London, Ont., to lay heating pipes on Richmond Street under track of C.P.R.

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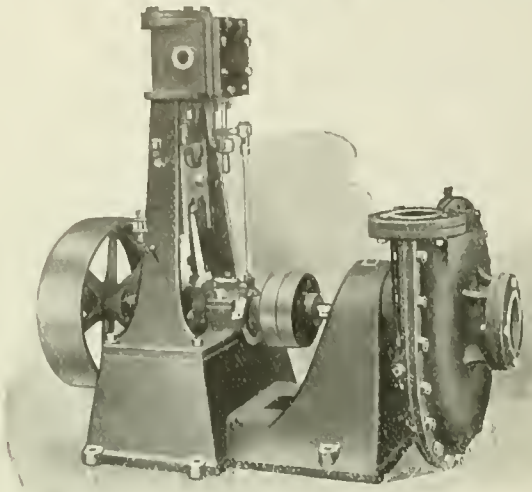

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## MARKET CONDITIONS.

Montreal, December 19th, 1909.

The present dullness in transactions in pig iron and in steel products, in the United States, is only temporary, and is the natural result of the previous heavy buying and specifying, coupled with the usual quietness incident to the close of the year. It was impossible that the immense volume of business put through in September and October last should continue, and the present lull is regarded as a healthy sign. The general view seems to be that the New Year will see a renewal of the upward trend of prices accompanied with a renewal of activity in trade. Prices of finished products are being maintained and, in fact, some further advances have been made during the past week, although pig is showing a weakness in some quarters. It has practically been decided that prices on Lake Superior ores will be advanced 50c. per ton, and consumers at Atlantic ports are being compelled to pay 40 to 50c. per ton over last year's figures. The high prices for coke and coal will add very materially to the cost of production and there is therefore no probability of any concession in prices. Specifications for structural material and railway supplies, such as rails, locomotives, cars, etc., are being received by the mills in a satisfactory manner, many of the mills being several weeks behind in their deliveries.

The English and Scotch situation is showing a more hopeful tone, once more. The home trade is picking up and there appears to be a better feeling, generally. Export trade is not satisfactory, but even this is showing some improvement, especially as the advances in the United States and Germany are likely to open markets in these countries for tonnage of British manufacture. Pig-iron markets have developed strength, showing an advance of 1s to 1s 6d, during the week. It is pointed out that steel making irons will all be higher in Great Britain, than it was this year, owing to the fact that Spanish mine owners, who supply the bulk of the ore, are insisting on prices delivered at Middlesboro and Glasgow, of 15s per ton, all against 14s 6d to 16s, during the first half of 1909, and about 17s 6d of recent months.

Structural trade shows no sign of abatement. Inquiries are being received very generally for a liberal tonnage, and several good contracts have been placed during the past week. Many good consumers are now inquiring for prices for delivery during the last half of 1910, thus indicating that present prices are likely to be maintained for some considerable time to come. Canadian furnaces are declining to quote thus far ahead and it is practically impossible to get satisfactory prices from English or Scotch makers, they are feeling satisfied that conditions are going to show an improvement. In the meantime, the metal hold is being rapidly taken

**"FLEUR DE LIS" Galvanized Iron**

Will work as well as "Queen's Head." Not so heavily coated.

JOHN LYSAGHT, LTD. Makers, Bristol.
A. C. LESLIE & CO., LTD. Montreal. 6

out and foundries requiring further supplies for winter consumption are being required to pay higher freights.

The markets for finished and semi-finished material are very dull and uninteresting. It is impossible to get prices up here, notwithstanding that several lines are being advanced in almost all other markets. Dealers are awaiting the turn of the year, it being their hope that the market will be stronger and more active, thereafter:—

**Antimony.**—The market is steady at 8 to 8¼c.

**Bar Iron and Steel.**—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.90; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal

**Copper.**—Prices are strong at 14 to 14¼c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, ex-store, Montreal, prompt delivery; No. 1 Summerlee, $21.50 to $22 per ton; selected Summerlee, $21 to $21.50; soft Summerlee, $20.50 to $21; Clarence, $19.50 to $20; Carron, No. 1, $21.50 to $22, and Carron special, $21 to $21.50.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady at $3.55 to $3.65.

**Lead Wool.**—$10.50 per hundred, $200 per ton, f.o.b., factory.

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ⅜-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ¼-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50;

# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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## The Canadian Engineer

ESTABLISHED 1893

**Issued Weekly in the interests of the**

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

**Editor**—E. A. James, B.A.Sc.
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TORONTO, CANADA, DECEMBER 31, 1909.

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## A HAPPY AND PROSPEROUS NEW YEAR.

## CANADIAN SOCIETY OF CIVIL ENGINEERS.

Will meet in Ottawa
January 25th, 26th and 27th, 1910.

Many important committee reports will be considered.

Several excursions to works of great interest to engineers will be possible.

The dinner on Wednesday evening will be the most brilliant and entertaining and social yet held.

Ottawa is central, the home of many engineers, the headquarters for large engineering interests, and has a strong branch of the Canadian Society, whose members will be glad to greet you.

## A SOCIAL CLUB FOR ENGINEERS.

As a city of homes Toronto has been growing until her population is over three hundred and fifty thousand; as a commercial metropolis Toronto has now greater postal revenue and customs returns than any Canadian city, and as an engineering centre Toronto has increased in importance, but has not come to her own because of two great lacks—a comprehensive library and a social club, controlled by architects, chemists, contractors, surveyors and engineers.

Toronto is the only city of such size and importance which lacks such institutions, either separate or combined, which are necessary in centres where technically trained men work.

The daily press of Toronto has had some reference to the formation of a social club for engineers. We are not informed as to the details of the scheme, but feel certain it will be pushed forward to successful completion.

A social club composed of engineers, architects, contractors and business men with like interests would at first be a great convenience, and afterward a necessity. It would become a centre around which the technical societies of the city would group, and might become the home of a well-equipped and extensive technical library.

The doctors, the lawyers, the dentists, and even the clergy, have their organizations, with permanent secretaries, housed in well-equipped offices and surrounded by a staff equal to the work of protecting and safeguarding the profession and the individual in the profession.

The technical men of Toronto and vicinity would greatly benefit if they had such an organization looking after their interests. A society with a secretary and librarian, who would devote his whole time to carrying out the direction, performing the routine work and

assisting the secretaries of the various technical societies to act as centre; a club where men with common interests would meet and exchange greeting; a club where the visiting engineer or architect could be entertained and quickly meet the men of his profession that reside in this city.

Toronto requires such a club—and requires it now, and we wish the men behind the movement every success.

## BRIDGE DESIGN.

Mr. L. H. Chase, M. Inst. C.E., Great Britain, read before the Liverpool Engineering Society recently a paper on the "Theory of Suspension Bridges."

The author criticizes the statement of Prof. Rankine when he says: "The effect of the stiffening girder is to distribute a partial uniform load uniformly all over the chain."

The author then proceeds to develop formulæ which explain his contention. Two cases were considered, namely, a bridge with a hinge at the centre of the span, and a girder without a hinge. In the first case the resulting formula is $x = 2W\frac{c}{L}$ where $x$ is the load carried by the cable, W a concentrated load at a point $c$ feet from the abutment, and L is half the span. In the second case

$$x = WK\frac{1}{1 + \frac{c}{g}}$$

where K is a factor varying with the position of W and representing the ratio of the average deflection of a detached girder, due to a concentrated load, to the average deflection, due to the same load distributed; $c$ is the average deflection due to any load distributed uniformly on the suspenders of the detached cable; $g$ is the average deflection of detached girder due to the same load distributed.

## VOLUME XVII.

With this issue we close another volume. The index for the numbers since July will be found on page 43, and by glancing over the list of authors and subjects readers will secure some idea of the field we have endeavored to cover.

We have placed the index on the last few pages, so that it may be detached and placed in the first issue of Volume XVII.

Volume XVIII. will, editorially (advertisements included) and typographically, be superior to any yet issued.

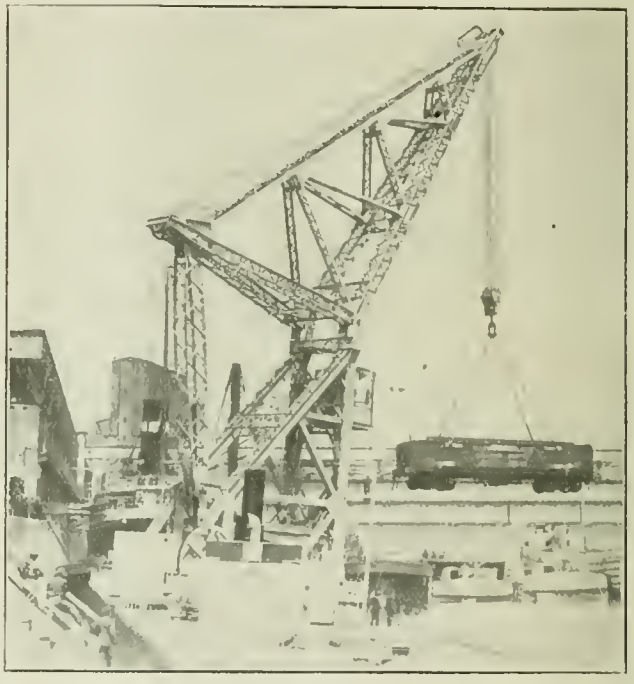
## EDITORIAL NOTE.

The total returns of the Dominion for the eight months of the fiscal year to November 30th amounted to $439,959,213, an increase of $62,037,972, compared with the same period last year. Of this increase, $45,-289,968 was in imports and $14,970,238 in exports. For November the total trade was $73,151,731. The imports for the month increased 40 per cent. and the exports 10 per cent.

## 75-TON FLOATING CRANE.

The continued growth of shipping at the port of Montreal has made necessary improvements in methods of transhipping. Recently the Montreal Harbor Commissioners added to their equipment a 75-ton floating crane. The design used was the outcome of a careful consideration of the relative advantages of floating and permanent. The crane selected can be taken alongside of any ship at any berth. Its radius can be varied: it can deal at a height of 100 ft. above water level, with loads from 75 tons downwards, and while suitable for unshipping such heavy units as locomotives, can be utilized on occasion for carrying the grain band conveyers loading ships in outer berths from barges, canal-boats, or warehouses. It has therefore a wide range of service.

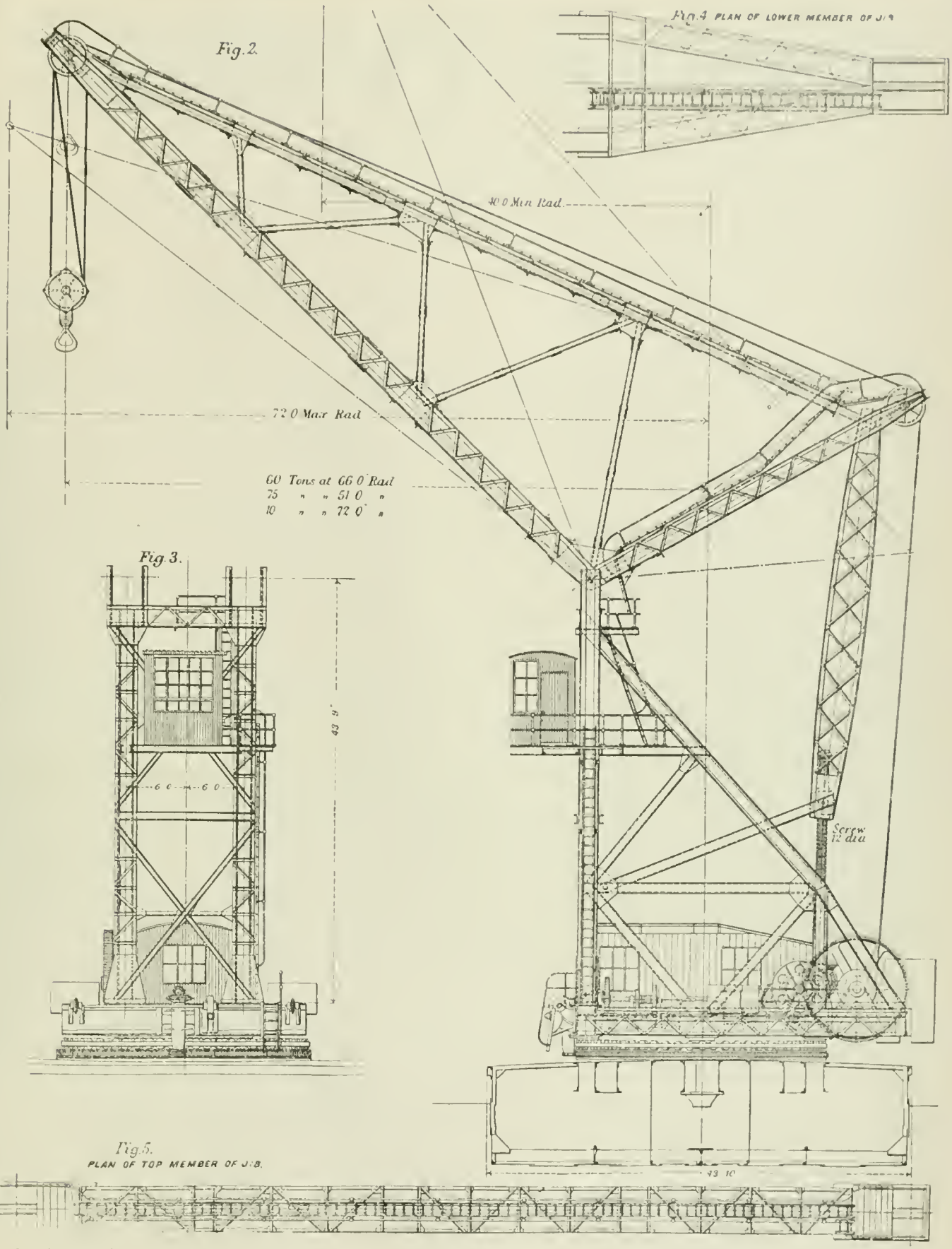
The crane, of which a perspective view is given above, and elevation, sections and plans on the opposite page, was built by Messrs. Applebys, Limited, Leicester and Glasgow, and the pontoon, boiler, engines, &c., by Messrs. Vickers Sons and Maxim, Limited, at Barrow-in-Furness. This pontoon is of the following dimensions:—



**Harbor Crane Raising Load.**
(Photo by The Montreal Star.)

| | |
|---|---|
| Length, moulded | 200 ft. 5 in. |
| Breadth, moulded | 43 ft. |
| Breadth, extreme | 43 ft. 10 in. |
| Depth, moulded | 10 ft. |

The pontoon is strongly made, of mild steel, and has been built under the supervision of Lloyd's surveyors for their special class. A centre line bulkhead is built between the end bulkheads, and before and abaft these is tapered to the bottom. Strongly-built girders, well supported by deep floors, are fitted on each side to resist the strains set up under the varying conditions of working. Six transverse bulkheads are fitted, and the necessary store-rooms, &c., are placed in the hold of the pontoon between these bulkheads. A strong elm fender is fitted all round the pontoon at the level of the deck, securely bolted between angles. A walking gangway of white pine is fitted all fore and aft on the top of the floors on each side of the pontoon. A rudder, worked




by hand gear, is also fitted. The pontoon is well cement-washed on the inside and suitably drained for pumping out. In order to ensure the safety of the crane, 300 tons of ballast are placed well down between the floor-plates, and distributed in such a manner that the weights upon the structure will be even throughout, and thus avoid undesirable straining.

Specially arranged balance-weights are fitted to minimize the angle of heel. One of these weights is fixed on

base at the crane on the side remote from the jib, and the latter is in the form of a truck, and can be adjusted to assist the balancing under varying loads. The lower part of the crane is fixed to the revolving table, which has a range of 360 deg. The jib is hinged at the top of strongly-built uprights, and can be adjusted by means of a connecting-link girder attached to a large screw. The centre-pin is of massive proportions, and strongly-connected to the structure of the vessel. The roller-path on which the crane revolves is well secured and bedded to the deck, and strongly supported by bulkheads and girders.

The crane is proportioned for handling a maximum working load of 75 tons at a radius of 51 ft., 60 tons at a radius of 66 ft., and 10 tons at a radius of 72 ft., the minimum radius of the crane being 40 ft. The height of lift is 100 ft. above the water-level when the crane is working at 51 ft. radius.

Four motions are provided—viz., hoisting, derricking, slewing, and ballast adjusting. Two sets of double-cylinder horizontal steam-engines are provided for working the above motions (Fig. 6): one set with cylinders of 9-in. bore by 18-in. stroke for hoisting and derricking, and one set with cylinders at 8½-in. bore by 12-in. stroke for slewing and ballast adjusting. The hoisting-gear consists of three reductions of steel spur-gear. The load is lifted on eight parts of extra flexible best plough steel wire-rope, winding two parts, the drum being grooved right and left hand. Change gear is provided on the hoisting motion in order to give three speeds of lift. The derricking is worked off the second-motion hoisting-shaft by means of one further reduction of spur-gear, one bevel-gear and a large screw, working into a gun-metal nut fixed to a swivelling crosshead attached to the lower end of a steel link, the upper end of which is connected to the back end of the jib.

The crane revolves on a set of live rollers (Figs. 2 and 3). The bottom roller path is a complete cast-steel circle, having teeth on the outside, with which the slewing-pinion engages. The slewing-gear consists of two bevel-gear and two spur-gear reductions (Fig. 6); two speeds are provided.

The ballast-adjusting mechanism includes one bevel-gear and one worm-gear reduction. The travelling counter-weights on each side of the crane are racked in and out by means of flat-link chains working on sprocket-wheels.

The crane structure (Figs. 2 and 3) consists of a revolving turntable carrying a double triangular frame, on the apex of which the jib is pivoted. The jib is a lattice structure, having two bottom booms and one top boom, forming a triangle.

The various motions are controlled from the driver's cabin, which is situated in an elevated position in front of the crane. The speeds at which the various motions can be performed are as follow:—

Hoisting.....75 tons at 3 ft. per minute.
" .....25 " 9 "
" .....10 " 20 "
Slewing .....75 tons at one revolution in 4 minutes (slow gear).
" ..... 10 tons at one revolution in 2½ minutes (fast gear).
Derricking .....From maximum to minimum radius in 8 minutes.

Steam is supplied to the engines at a pressure of 80 lb. by a large vertical boiler situated on the pontoon, with a funnel fitted up through the centre-pin of the crane.

The pontoon has been fitted with a portable self-contained grain-elevator, which is fitted with a bridle to suspend the apparatus from the hook of the floating crane when required. The grain-elevator is worked by an electric motor, and has a capacity of 80 tons of grain per hour. A dynamo is supplied and fitted suitable for supplying power to the grain-elevator and for the electric lamps with which the pontoon and crane are fitted up. Two powerful arc-lamps are also fitted on the deck of the vessel.

The pontoon has been fitted with a powerful steam warping-capstan, and is supplied with all the usual fittings for this class of vessel, and is also fitted up to fulfil the Board of Trade requirements, a lifeboat and other accessories being supplied.

## AWARDS FOR WATER AND WATER POWER DIVERSION

At the convention of the New England Waterworks Association held September 12, 1907, a resolution was passed "that a committee of five be appointed by the president to collect data relating to awards that have been made for damages resulting from the diversion of water; also to consider the practicability of joint action with the National Cotton Manufacturers' Association, or other organizations of mill owners, relating to the formulation of standard rules of computing or assessing damages for the diversion of water."

This committee consisting of Charles T. Main, chairman, Boston, Mass.; Leonard Metcalf, secretary, Boston, Mass.; Richard A. Hale, Lawrence, Mass.; Charles E. Chandler, Norwich, Conn.; William Wheeler, Boston, Mass.; has just rendered its report* which contains valuable information.

In the fundamental data which are given only one series of facts stated is the work of the committee—the computation of the unit basis of award or agreed selling price; that is, the amount thereof "per square mile per foot of fall," or "per million gallons daily per foot of fall."

Why, it may be asked here, did this committee select the unit basis adopted for comparison of the information contained in these circulars?

Direct comparison was impossible for obvious reasons. A comparison of the amount of the awards or the prices agreed upon could not be compared upon a horse-power basis without involving questions as to the character of the use, the hours of use, (whether for 24-hour power, 10-hour power, or any other period), and without the exercise of judgment by the committee or of the experts employed upon the different sides of the case.

For this reason it seemed wiser to the committee to adopt as a standard unit of comparison in these cases, the amount "($) per square mile per foot of fall," or "($) per million gallons daily per foot of fall." These standards are relatively fixed and easy of determination, for there is usually substantial agreement by the experts as to the extent of the watershed involved and the actual available fall.

The summarized results include statements of the total watershed above the damaged property, the amount of watershed from which water was actually diverted, the available fall, the unit prices paid, either per square mile per foot of fall or per million gallons daily per foot of fall, and a few significant remarks, all grouped into four broad classes as follows:

*The complete report will appear in the Journal of the New England Waterworks Association.

(Continued on page 726.)

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## DOMESTIC WATER SUPPLY BY METER.

The Water and Gas Review for the current month quote and comment upon an article we lately published, entitled "Toronto Water Supply and Waste."

Several authorities are quoted by the above Review in favor of a meter supply system. The quotations appear to be in answer to a statement made by an Assistant Commissioner of Health of the city of Chicago, wherein the policy of metering the supply for business purposes is advocated, but for domestic supply is condemned on sanitary grounds.

The authorities quoted are fairly unanimous in concluding that the above Assistant Commissioner's conclusion is not warranted in assuming that decrease in health efficiency will follow the introduction of a domestic meter supply system.

Two points of view are strongly held, viz.:—

(a) Sewers receive practically no cleansing benefit from casual waste.

(b) The amount of supply for legitimate domestic purposes is not diminished by the introduction of meters as long as "a minimum charge per annum," guaranteeing the user all the water he can possibly use at a moderate figure is adopted.

The Water and Gas Review, referring to our statement that it is not usual to adopt meter service in Great Britain, where the per capita supply is low, states that this is owing to thoroughness of inspection, which in American cities would be a practical impossibility owing to political complications arising from frequent changes in administration.

As far as the United States is concerned, we have no quarrel with the latter statement, but we cannot see that it holds good in Canada. Continuity of municipal policy is just as much a factor in Canada as in Great Britain. The argument of chaotic politics does not hold good on this side of the line.

With reference to the point of view (a): "Sewers do not benefit," etc., we quite agree, and it is our point that the 21,500,000 gallons pumped to waste every day in Toronto serve no good purpose whatever.

With reference to (b), the adoption of the meter system for domestic supply in Toronto would certainly have the effect of causing scores of householders to call in a plumber to repair fittings, and show a consequent reduction in the gross amount of water supply at an early date, while the per capita supply would, no doubt, continue on the average to show a sufficiency of water for each individual, it would remain impossible, however, to arrive at minimum per capita supplies.

In Toronto we have a large population who are termed "roomers." These people generally occupy one or more rooms, with the use of the bath room. With the meter system we can conceive of the parsimonious landlord or landlady preferring to let rooms to people who are content to miss the morning tub, rather than indulge.

The point, however, remains that with proper and efficient supervision of plumbing fixtures and good, sound mains, the per capita supply for domestic purposes need not exceed thirty gallons per day, and this without the trouble and expense of fixing meters to each individual house service. Not having similar political conditions to those in the States to contend with in Canada, can we arrive at the same point in efficiency decrease in waste here as in Great Britain?

Nothing is said in the Gas and Water Review of the cost, maintenance and depreciation in connection with a meter system. Nothing is said of the trouble and worry in connection with untruthful meters.

In Toronto to provide an universal domestic meter supply in accordance with the city waterworks engineer, C. L. Fellowes, would entail a capital expenditure of $720,000. At 4 per cent. this sum represents annually $28,800. A sinking fund for depreciation at 2 per cent. represents a further annual sum of $14,400. Repairs at 2 per cent. entail a further annual payment of $14,400. A meter system based on the above figures would cost Toronto an annual sum of $57,600.

The above sum, of course, includes no part of the cost to the individual in keeping in repair taps and fittings, and the introduction of meters would certainly cause a huge annual expenditure in this direction.

Now, the question appears to us to be simply this as far as Toronto is concerned: Are the people willing to pay the annual sum of $57,600 to maintain a meter system, or would they rather pay half this sum to ensure the establishment of a thorough system of water appliance supervision such as exists in most British cities and towns?

Twenty-eight thousand eight hundred dollars would, roughly, provide for a staff of twenty-eight qualified inspectors at $1,000 per annum each, and should result in water fittings being put in of such a character that annual maintenance in rectifying defects would be reduced to a minimum.

There is at times apt to be a tendency in connection with municipal supplies to the public to assume the total cost of the supply only as equivalent to the rates, etc., paid direct by the public to the municipality and ignore all the incidental costs which are entailed to the individual as a consequence of the supply.

For example, a municipality may introduce a meter system, charge rent for the meter, and call this "income," and deduct the sum from "expenditure."

All such tricks are only on a par with taking a sum of money from a man's pocket and returning it to an-

other of his pockets and trying to persuade him he has obtained something.

Every cent that a water system costs, whether paid direct as a tax or rate or to the private plumber for repairs to fittings, is part of the cost of the water provided.

The more simple the method of water supply the less complicated by mechanical appliances, such as meters, the more efficient the supervision of plumbing work by the municipality in connection with new buildings or repairs to old, the less will be the total cost to the individual for a free, unbounded supply of water for all purposes represented at a per capita figure of about thirty gallons per day.

## NOTES ON THE METER QUESTION.*

"A few years ago an Assistant Commissioner of Health of the City of Chicago placed himself on record as opposed to the introduction of meters in dwelling houses by the following statement: 'The City Health Department,' he said, 'is uncompromisingly opposed to the installation of meters in dwellings, but favors putting them in factories, business blocks and all other buildings where water is used for commercial or ornamental purposes. The opposition of the department is based on sanitary grounds and the general protection of the public health. Running water is one of the greatest of all sanitary agents. It absorbs foul and noxious gases, is a dilutant of filth and a carrier away of excreta. If the flat buildings and tenement houses of this city should be equipped with meters, resulting in a decreased use of water, as would be the case, there would be an instant and heavy rise in the death rate. There can be no such thing as a waste of purifying agent like water in a dwelling house, and with Chicago's unlimited and inexhaustible supply there should be no limit placed upon the amount to be used for domestic purposes.'"

As this statement was of rather a radical nature, and quite at variance with well-known facts, it was deemed advisable by the Review to submit it for the opinions of a few water-works engineers and superintendents. Here is, in part, what some of these gentlemen had to say. They very explicitly controverted the statement of the Assistant Commissioner of Health at the time, and will serve now as a supplemental answer to the publication named:

'I most positively disagree with the views that the metering of tenement houses would cause a heavy rise in the death rate of Chicago. In the first place, it would not follow that the placing of meters as above stated would cause a decrease in the use of water; it would undoubtedly reduce the consumption, but that is a different matter.

'I am at a loss to conjecture what he bases his opinion upon. He certainly cannot find any support for such an opinion in the experience of cities that have meters in general use. Water is, of course, a purifying agent, but no one who has given the matter much study believes that the constant running of water from a leaky fixture has any cleaning or purifying effect; rather, on the contrary, the belief is that such streams have an unsanitary effect inasmuch as they merely stir up the foulness in the drainage appliances causing the emanation of injurious gases therefrom, which have been known to cause illness in more than one instance.

'As to there being 'no such thing as a waste of a purifying agent like water,' there certainly can be, and what is more, there is surely a grievous and deplorable waste of this great purifying agent, for which it is applied for the purpose of cleansing in any other way than by what is known as 'flushing,' it fails in its effect and is wasted.

'Every man engaged in the maintenance of public sewers knows that, notwithstanding the number of small streams constantly pouring into them, if they are not occasionally flushed out they would become eventually clogged up tight. Furthermore, it is well understood that water mains carrying water at their full capacity under great pressure have to be 'blown out' in order to remove sediment, etc., which accumulates on the bottom and sides of the pipe.

'A very common mistake is made by people not having a practical knowledge of waterworks matters in assuming that meters are intended to curtail the legitimate use of water instead of being aimed at the monstrous, unjustifiable and unsanitary waste of an extremely valuable commodity.' —Robert J. Thomas, Superintendent Waterworks, Lowell, Mass.

'In response to your inquiry as to the detrimental effect of water meters on the public health of a community, I would say that in all my direct experience and study of the subject, I have never encountered any valid sanitary objection to the use of such meters, when the same are made of insoluble or non-corrosive materials and according to a national design. In some cases, complaint has been made of noisy action, in others stoppages have occurred in consequence of the formation of rust when the premises have been unoccupied for a considerable period of time, and occasionally the brass work becomes slightly affected; but none of these causes has ever been sufficient to injure the health of the persons who use the water which passes through the meter.

'The assumption that the installation of water meters in a city will result in ' an instant and heavy rise of the death rate,' is wholly unwarranted and cannot be regarded seriously. Not the slightest foundation for making such a statement can be adduced if the water itself is wholesome. The only vestige of a reason for such a deplorable consequence is that by reducing useless leakage and waste in the water fittings of a household, the drain pipes will not discharge as much liquid as before, whence the inference is covetly conveyed that the drains will not be properly flushed or rinsed. This inference, however, is entirely wrong, as the dribble from a leaky faucet has no flushing power whatever, and is incapable of absorbing any appreciable quantity of foul gas, or of diluting or carrying away any filth that may have been lodged on the inner surface of a drain pipe.

'Efficient flushing can be done only when the volume of water is large enough to nearly fill the pipe, and pass through it rapidly like a piston. A few such flushes will clear the pipe as well as if the water were running constantly at the same high rate, just as one thorough washing of a dish makes it as clean as if it were kept thereafter continually in a flowing stream. In all modern sanitary appliances, care is taken to provide ample flushing capacity for keeping the pipes clear, and the use of water in excess of this becomes waste. Furthermore, the quantity of such flushing water cannot usually be controlled by the householder, but is fixed by the maker of the appliance, whence it follows that the legitimate consumption is not reduced by having a water meter in the premiss.

'The constant dribble from a single leaky faucet may easily become, in the course of twenty-four hours, more than the legitimate use of an entire family. By actual measurement, the quantity of water thus escaping ranges from 100 to 300

*The Water and Gas Review (December, 1909).

gallons per day, depending on the head; and as experience has demonstrated that from 35 to 50 gallons of water per head and day is ample for all ordinary purposes, the registration of avoidable leakage by the meter induces the thrifty householder to make repairs promptly, and incidentally causes the available supply to serve a large population.' Emil Kuichling, Consulting Engineer, Former Superintendent and Engineer of Waterworks, Rochester, N. Y.

'The contention that the introduction of water meters tends to lower the sanitary condition of towns by decreasing the use of water might be entertained by an occasional layman, who had not taken the trouble to inquire into the subject, but that a physician and public health officer, should make such a claim is, to put it mildly, surprising. Certainly, so far as our knowledge goes, no such effect has been noted heretofore in cities that have introduced the meter system extensively, such as Atlanta, Atlantic City, Cleveland, Fall River, Providence, Worcester and Yonkers. The facts, in any case, may be readily obtained from the health statistics of those places.

'Unquestionably, if the lowest classes of the population of a city were to pay pro rata for all water used there would be a tendency to use too little water to insure sanitary conditions, but this danger is eliminated by the minimum rate provision by which the poorest water taker may draw an ample supply for purposes of health. Beyond this, water used for purposes of luxury or water wasted should be paid for at such a rate as to equitably compensate the city or company that furnishes it.

'Having had considerable experience in connection with sewerage works I may say with confidence that the introduction of meters in an American city will not increase the percentage of solids suspended in the sewage (usually about one or two parts per 1,000) to such an extent as to be objectionable in any ordinary sewerage system. On the contrary, where the sewage has to be pumped or treated, there is an economic advantage in the slightest decrease in volume.

'In short, the net result from metering a water supply appears to be, first, in restricting waste; hence, second, in decreasing the annual cost of operation, and, third, in equitably apportioning the charges for water, as under any other system the water wasted by one taken is largely paid for by his more economical neighbor.'—Kennet Allen, C.E., Engineer and Superintendent Waterworks, Atlantic City, N. J.

'I have found that water-taking communities are roughly divisible into two great classes:

'(1) Those who know something of the water meter, and who have only a compassionate smile for communities still adhering to the antiquated schedule system, and

'(2) Those who are 'uncompromisingly opposed to the installation of meters.'

'The assistant commissioner of health of Chicago appears to be unaware of certain important facts.

'1st. That it is usually, if not universally, the practice, in applying meters, to establish a minimum charge per annum, guaranteeing the user all the water he can possibly use at a moderate figure, usually less than he would pay by schedule, so that there is no inducement to the user to be economical in his use of water.

'2nd. That, as the experience of many communities has shown, the vast majority of the population, while using water with perfect freedom, nevertheless use it decently and rationally, while the waste is perpetuated by a very small minority, usually between 10 and 20 per cent. of the entire population, who recklessly throw away, without benefit even to themselves, more water than they and all the others combined can possibly use.

'3rd. That the oceans of water thus wasted, flowing sluggishly through our large sewers, exert little or no cleansing effect, whereas a very much smaller quantity discharged into the sewers periodically, at a high velocity, would really be of some benefit in a sanitary sense.

'While Chief of the Bureau of Water of this city, between 1895 and 1899, I had excellent opportunity to study the effect of the non-use of meters upon the sanitary conditions of our dwellings.

'As you may be aware, we were between the devil and the deep sea, the devil being represented by an organization which was holding up all appropriations for the benefit of an administration more to its liking, while the deep sea was a public 'uncompromisingly opposed to the installation of meters in dwellings.'

'We begged for meters in order that the supply might be put upon a sensible basis, but the refusal of this request was of course a foregone conclusion. We begged for pumps in order that we might supply more oceans of water to be wasted by a few careless or unscrupulous people, in order that the majority might have enough for their needs, but the organization turned a deaf ear to this request.

'With our existing pumping facilities, a general use of meters would have made the supply ample for all. As it was, I was overburdened with daily complaints from people who could not obtain water enough to flush their closets, and all because of 'uncompromising opposition' from people who did not know what they were talking about and would not take the trouble to learn.'—John C. Trautwine, jr., Consulting Engineer, Philadelphia, Pa., Former Chief of the Bureau of Water of that City.

'In regard to meters in tenement houses, as the landlord pays the water bills the tenants do not restrict themselves in the use of water for the landlord's sake, the charge does not come out of their pockets; on the other hand, the putting in of meters has the effect of making the landlord use the very best appliances to prevent waste, hence there is better sanitary conditions than running water will ever bring about. I believe that the only equitable way to furnish water is by meter measurement, and with a proper allowance for a minimum rate there will be no trouble from a sanitary point.'—R. N. Ellis, Superintendent of Waterworks, Jacksonville, Fla.

'In reply to your inquiry, asking my views upon the effect of meters upon the health of a community, I would say:

'1st. The records of the Health Department have been carefully examined several times to see whether there is greater sickness among the 20,000 houses that are metered than in the case of the 35,000 that are not metered. We cannot find any difference.

'2nd. The able Chairman of the Board of Health, Dr. M. Rosenwasser, and Mr. Geo. C. Whipple, the most eminent expert on Water Analysis in the United States, I suppose, have examined the slight deposit of mud that collects around the fish traps of our meters, as it does in all other portions of any pipe system, and have reported that they find no evidence of contamination or of disease germs more than would be found anywhere else in the system.

'3rd. Certain extensive correspondence with cities that have used the most meters shows similar results, and the meters are not in any way productive of ill health.

'4th. The meters have a tendency to improve the health of a community, because when people pay for the water used, rather than in proportion to the number of closets, faucets, etc., they are not so much tempted to restrict the number of closets in a house and of bath tubs.

'5th. A minimum rate as we have so compels people to pay for a considerable amount of water whether they use it or not. The temptation for undue economy in the use of water is taken away. Especially is this true after the first six months, as shown by people who have been greatly economizing and have used less water than they are entitled to. Our lowest minimum of $1.25 for six months, joined to a regular water rate of only 40 cents a thousand feet, or 5⅓ cents a 1,000 gallons, allows one to use 130 gallons per day. This is sufficient to flush a water closet 20 times every day; allows 42 gallons a day for cleaning; 50 pint glasses a day for drinking, and enough to completely flush out three times a day 200 feet of ¾-inch pipe if there be that amount running from the street main to the faucet.

'6th. Any knowledge of sewage would show that the flushing of sewers would not be greatly affected by the reduction in water pumped through the saving effected by meters. The great flushing of sewers is done by rains.

'7th. It is absolute nonsense to state that there is an unlimited and inexhaustible supply of water in Cleveland or Chicago or anywhere else, unless we assume an equally inexhaustible supply of money in the hands of people with which to pay for the costly pumps, street mains, tunnels or other apparatus necessary to get such supply of water to the consumer.

'8th. Meters lead consumers to stop the great source of waste which does not come from the water they drink or use for cleaning, but what they waste through leaking pipes and trickling streams in closets. Any such leaks are no benefit, but rather tend, if there are leaks in pipes to cause mold and unhealthful dampness in a house or basement. The renovation of plumbing which generally comes in such houses after meters are set would be pronounced by any sanitary expert to be an improvement on the former conditions of the house.

'9th. Nearly every report of any expert commission upon the improvement of the water supply of any city in America has been accompanied by a recommendation for meters, and never by a recommendation against them. Of course, no expert commission or engineer would recommend meters if they were going to destroy the value of the improved water supply, which they recommend in the same report.'—Prof. Edward W. Bemis, Superintendent Waterworks, Cleveland, O.

'Selling water by meter measurement does not imply a stinting in the use of water, unless the water is sold at actual measurement without a minimum charge. To encourage the liberal use of water we have fixed a minimum charge of $2.00, per six months, for 1,500 cubic feet of water. This gives an ordinary family 61 gallons of water per day, nearly two barrels. We adopted the general meter system in 1888, now nearly sixteen years. We have over 3,400 water takers, 96 per cent. of which are metered. Being a university town, we have a great many tenement houses, and we have yet to hear of a healthier city in the country. The main issue of a water supply is a good and wholesome water, a general meter system, because it is not fair to restrict the commercial or ornamental water and allow the wanton waste of water in dwellings. Running water is one of the greatest of all sanitary agents, but it is not necessary to be under constant flow, wherewith it requires a constant adding of pumping machinery, and even with that, reduces the required fire pressure. A city has no right to allow classification of its citizens endangering the property of one against the other by want of sufficient pressure caused by the misuse of allowing the water to run a constant flow. There is more danger of foul and noxious gases in restricting the use of water in factories, where hundreds are employed, than in dwellings.

'The same question was raised against our adopting the general meter system in 1888. It was claimed that it would be detrimental to the health of our city. Our records of health during all these years will prove just the contrary, and a correspondence with our board of health and with our physicians, especially of those that have practised during the past sixteen years, will verify my statement.

'A general meter system, with rates to encourage a plentiful use of water, is the only fair system of selling water to both the city and consumer, and a safeguard against large conflagrations, the water pressure being ever ready when the fire is still in its incipiency.'—John B. Heim, Superintendent of the Waterworks, Madison, Wis.

"The reference to towns in Great Britain also needs some amendment. In Manchester and several of the larger English cities it has been for many years the custom for the city to supervise the plumbing very closely, testing every fixture before it is allowed to be used and stamping it with an official seal if satisfactory in make, material and style, and properly passing the prescribed tests. In one small English town where the plumbing had become so hopelessly bad that repairs seemed impossible the water department practically installed new and satisfactory fixtures in every house before attempting to control leakage and wastage.

It is true that in Great Britain water meters are not extensively employed—but even there they are coming slowly but surely into use—nearly all the water used for domestic purposes being paid for on the basis of the rental value of the property occupied by the consumer instead of being based, as is commonly done in America, on the frontage rates with additional charges for the extra fixtures in use; and the control of wastage and leakage is effected by frequent, thorough, house-to-house inspections coupled with the use of only approved plumbing fixtures. In these cities, however, the municipal organizations are very different from those in our American cities. With our political complications arising from frequent changes of administration it has always been impossible to accomplish lasting reforms, in the matter of waste suppression, by means which have been satisfactory in other countries. With constant changing of the heads of departments and of the members of council, and committees on whom reliance must be placed for appropriations, reforms inaugurated by one administration may be discontinued by the one succeeding and probably before any substantial benefits may have been secured. This is the condensed history of waste reduction by inspection in the American cities which have tried it."

## A UNIQUE CAR BARN HEATING SYSTEM

The new system of heating installed in the car barn of the Toronto and York Radial Railway, at Claire Avenue Toronto, Canada, is unique. In place of a steam boiler, which in ordinary car barns provides steam for heating but seldom for power, there will be a heater for transferring the heat in the coal direct to air, and a fan will force this heated air through the distributing system. The heater, which resembles a sectional water-tube boiler, is called an "air-tube" heater. It is the unique feature of this system which is being installed by the Harrison Engineering Company of New York City. This new method of heating will be watched with interest for there are no steam pipes or coils to be drained, no boiler to burst, and no accessories to be emptied or blown down in order to prevent freezing should it be necessary to shut down the plant during the winter.

# LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

**[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]**

## CORPORATIONS' CONTRACTS SHOULD BE UNDER SEAL.

In dealings between man and man each person is known by his signature. In trivial and everyday matters word of mouth is sufficient but in most matters of importance the signature is essential and when given is binding. But corporations stand in a different category; to be sure the law calls them "persons" and refers to them as such but it is only the law that does so. The corporation in the words of one learned judge "has no body to be burned and no soul to be damned." It has no existence in substance or in being but is a "legal entity," having an existence and rights to the mind only and being able to contract only by grace of the law.

How then are we to know when the corporation is bound? And the law has replied that some special formality must be oberved and, searching for an observance not entirely new or strange to jurisprudence, has decided that this should be a corporate seal.

In some matters the attachment of the corporate seal would be a nuisance and almost an impossibility, and corporate contracts are allowed to be good without it in such trivial matters as are wont to occur from day to day and again in matters of urgent necessity, e.g., where a municipal council suddenly finds itself face to face with some crises such as a fire which necessitates immediate action, and in which the council would be neglecting their duty if they failed to provide at once; here the courts will allow as good a contract made without seal on the spur of the moment, but as a rule require the seal.

**Hamilton vs. Niagara Harbor and Dock Company.**

The plaintiff sued alleging that the defendants had contracted to supply two engines and set them up in a steamboat belonging to the plaintiff, but was not able to produce any writing to that effect and failed by reason of that defect, the learned judge remarking,—"It is a leading principle in the law as respects corporations, that they can only contract under their common seal. The affixing of the seal of the proper authority is the only evidence or proof of the assent of the corporate body to the contract. There is reason in the principle. It is necessary for the protection of all the members of the body, that except in matters of common occurrence which are transacted in course, there should be something to supply the evidence of a joint contract."

6 U. C., Q. B., O. S.

**Smith vs. London Gas Company.**

The plaintiff sued the company upon a special contract to supply his hotel with gas but was not able to produce any written agreement. The court stated that as he failed to show any reason which could bring his case into any of the classes of exceptions, the general rule was applicable. His agreement may have been bona fide and deliberately discussed, entered into by both himself and the company, but as it lacked the formality required by law it could not be enforced.

7 Gr. 112.

Where a plaintiff has performed his part of the contract as, e.g., by doing the work, and the corporation has accepted the work and received the benefit the courts will seldom excuse them from payment.

**Perry vs. City of Ottawa.**

The Council of the Corporation appointed a committee with power among other things, to treat with and recommend to the council an engineer to make requisite surveys, etc., for supplying the city with water. This committee formulated a scheme for the construction of a reservoir on a hill in the locality, and the chairman of the committee swore at trial that they (the committee) employed the plaintiff to make plans, to be laid before the Commissioner of Public Works, of the hill in question in the action and of the reservoir proposed to be constructed upon it. Also that the plans had been necessary for the work of the committee and it was shown that the plaintiff was a well known engineer who had on other occasions done work for the city. It was shown that in due course the committee had made their report to the council and that the report contained what had been done by the plaintiff for them. The council had then by resolution approved and adopted the action of the committee.

The gist of the defence set up by the city was that no contract under the seal of the corporation was proved and that they were not therefore bound to pay the plaintiff.

One of the learned judges was inclined to think that the engineer should have been engaged by by-law under seal but found that as the work was embodied in the report and that had been accepted by council the city was bound to pay.

23 U.C., O.B., 391.

**Pim vs. County of Ontario.**

The plaintiff had been employed as a contractor in the erection of a court house and gaol for the County of Ontario. His employment had not been under seal, but he was able to show that he had worked regularly under inspection of the County Council's architect, a man authorized by resolutions of the Council to employ persons to do this very work. His evidence at trial also proved that he had completed the buildings, the value of the work, and that the defendants were in possession of the buildings, using them regularly as gaol and court house and council chamber.

The defendants disputed the claim for payment and the gist of their defence was that they were not bound as there was neither a by-law nor contract under seal to prove employment of the plaintiff. The Court after some remarks not complimentary to the defendants pointed out that in prior decisions there was a distinction made between executory contracts, those where the work was still to be performed and executed contracts such as this, where the plaintiff had performed his part of the contract and consequently the defendant had received all the benefit to which he was entitled in terms of the contract but refused to perform his own part in return. In this case the plaintiff had erected the buildings and the defendants were in possession and enjoyment of same,

and the Court refused to allow the defendants to escape payment.

Judgment for plaintiff.

Pim vs. Municipal Council of Ontario, 9 V.C., C.P., 304.

**Waterous Engine Works Co., vs. Town of Palmerston.**

The facts in this case were shortly as follows:—In April, 1890, the town council appointed a committee to consider prices and terms and advisability of purchasing a fire engine, and one month later the committee brought in its report recommending the purchase of an engine from the plaintiffs. The report was approved and adopted whereupon a contract was entered into, sealed by the engine company and signed by the mayor and clerk of the town with the corporate seal attached.

By the Municipal Act then, and apparently still, in force in Ontario (see R.S.O. Cap. 19, Sec. 544), town councils have authority to purchase fire engines upon petition of a majority of the ratepayers and by the passing of a by-law for that purpose. In the case in question, there had been no petition of ratepayers and no by-law but the council acted upon their own initiative.

The plaintiffs prepared an engine for the defendants pursuant to the contract and specifications attached and the same were delivered at Palmerston as per contract prior to 19th June. The council did not assume possession and control of the engine but the matter was brought up in council and three of the members were appointed to engage experts to be present when the machine was tested and investigate the working of the engine and appliances. On June 19th the engine was tested in the presence of these experts who reported satisfactory results. Three weeks later, the council passed a resolution that all negotiations be dropped and the plaintiffs instructed to remove the engine from the Town Hall where they had been allowed to shelter it.

The case reached the Supreme Court which held that, as a municipal corporation exists only by virtue of the Statutes and has only such powers as the Statutes say it shall have, and in this case the Statute gives power to purchase an engine after a petition by ratepayers and the passing of a by-law but not otherwise,—therefore, the signing and sealing of the contract in this case was ineffectual and void, for the mayor and council were attempting to do something beyond their powers and which was therefore void. Held that the contract was not binding at all upon the town and that the plaintiffs have no redress.

N. B.—That the decision might have been entirely different had the council already accepted delivery of the engine and been making use of it for purposes of the town.

21 S.C.R., 556.

**Clemenshaw vs. Corporation of Dublin.**

The municipal council proposed to buy out the rights of a local gas compny and as it was necessary first to get an Act through Parliament authorizing the move, they advertized for engineers to prepare plans, estimates, etc., to be used in support of the proposed application to Parliament and later. In answer to these the plaintiff applied to be employed and was informed that he had been appointed. He then entered upon his duties and at the bidding of the council did a considerable amount of work, but his appointment was not under the corporate seal. The council refused to pay him and he brought action for the amount of his accounts.

It was held that the appointment having been without the corporate seal was not binding and that the plaintiff could not recover.

Ir. R., 10 C.L., 1.

## PROBLEMS IN APPLIED STATICS.

T. R. London, B.A.Sc.

(Registered in Accordance with the Copyright Act.)

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

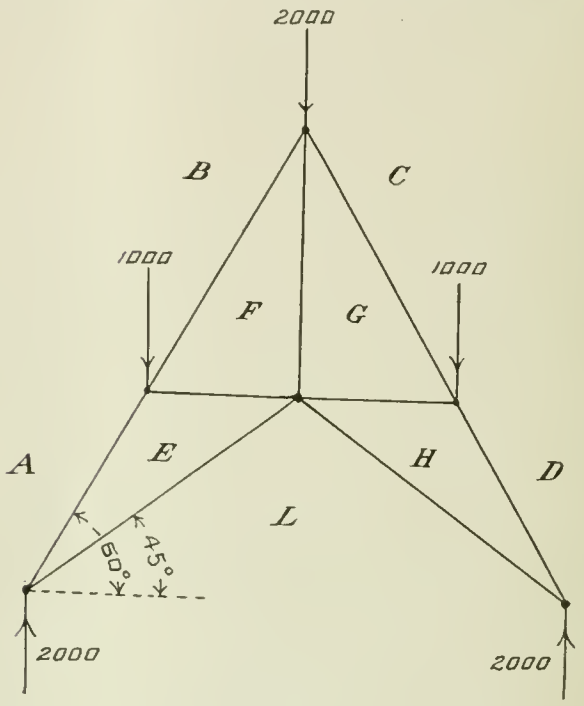



Fig. 96.

**Consider the forces acting at the point LEA.**

$$\Sigma X = X_{LE} + X_{EA} + X_{AL} = 0.$$

$$LE \cos 45° + EA \cos 60° + 0 = 0.$$

$$LE = -\frac{EA}{\sqrt{2}} \quad \ldots\ (4.)$$

$$\Sigma Y = Y_{LE} + Y_{EA} + Y_{AL} = 0.$$

In accordance with the assumptions as to the $X_{LE}$ and $X_{EA}$, the $Y_{LE}$ and $Y_{EA}$ will both be positive.

$$\Sigma Y = LE \sin 45° + EA \sin 60° + 2{,}000 = 0 \quad \ldots\ (5.)$$

substituting value of LE from (4.) into (5.).

$$\left(-\frac{EA}{\sqrt{2}}\right).\frac{1}{\sqrt{2}} + EA\frac{\sqrt{3}}{2} + 2{,}000 = 0.$$

$$EA\frac{(\sqrt{3}-1)}{2} = -2{,}000.$$

$$EA = -\frac{4{,}000}{(\sqrt{3}-1)} \quad (6.)$$

From the negative result, the assumptions as to $X_{EA}$ and $Y_{EA}$ are seen to be wrong. $X_{EA}$ and $Y_{EA}$ are, therefore, both negative; i.e., EA acts against the point. The member EA is in compression $\frac{4{,}000}{(\sqrt{3}-1)}$ pounds.

Substituting the value of EA from (6.) into (4.):—

$$LE = -\left(-\frac{4{,}000}{(\sqrt{3}-1)}\right).\frac{1}{\sqrt{2}}$$

$$= \frac{4{,}000}{(\sqrt{3}-1)}.\frac{1}{\sqrt{2}}$$

It follows from the positive result that the assumptions as to $X_{LE}$ and $Y_{LE}$ are correct; i.e., $X_{LE}$ and $Y_{LE}$ are positive. LE, therefore, acts away from the point.

The member LE is in tension $\frac{4{,}000}{(\sqrt{3}-1)}.\frac{1}{\sqrt{2}}$ pounds.

**The Queen Post Truss.**

The panel widths in the Queen Post Truss (Fig. 97) will be taken as equal. The forces acting on the truss are in equilibrium. Therefore, if in Fig. 97 moments be

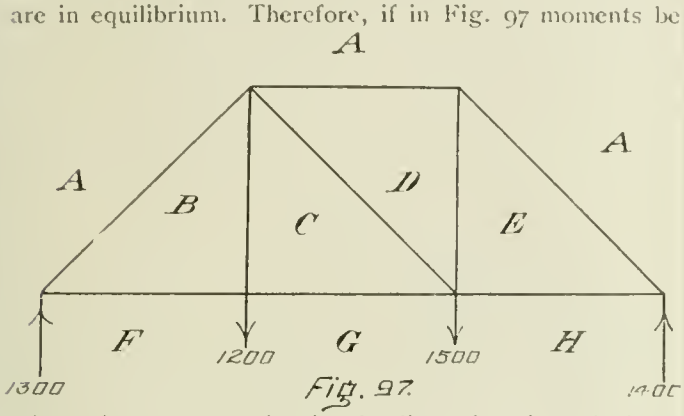


Fig. 97.

taken about some point in the line of action of either abutment reaction, and if the equation $\Sigma M = 0$ be ap-

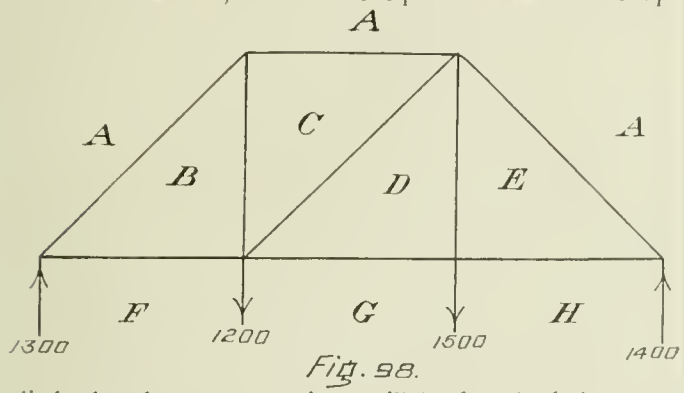


Fig. 98.

plied, the abutment reactions will be found of the magnitudes indicated on the diagram.

**Stress Diagram.**

Fig. 99 is the Stress Diagram for the truss, Fig. 97. In this diagram, the same system of double, thin, and heavy lines is used as in all the preceding Stress Diagrams drawn.

The reader is advised to construct Fig. 97 on a loose sheet of paper, and, as the stress in each member is found, indicate it on this diagram. This will enable one to see more clearly how the various Statical Diagrams are arrived at. (It must be kept in mind that the Statical Diagram merely represents the known forces **when the point is first considered.**)

If the following Vector Polygons also be drawn on a separate sheet of paper as they are pointed out in Fig. 99, using the same scale in each case, the construction of the Stress Diagram will then be more easily followed, for it is generally the presence of lines which have not yet been arrived at that serve to confuse the reader.

**Consider the point AFB** (Statical Diagram, Fig. 100). AF, FB, BA (Fig. 99) evidently form a Vector Polygon for the forces acting at this point. From this polygon, the force FB is seen to act away from the point and BA against the point. The member FB is, therefore,

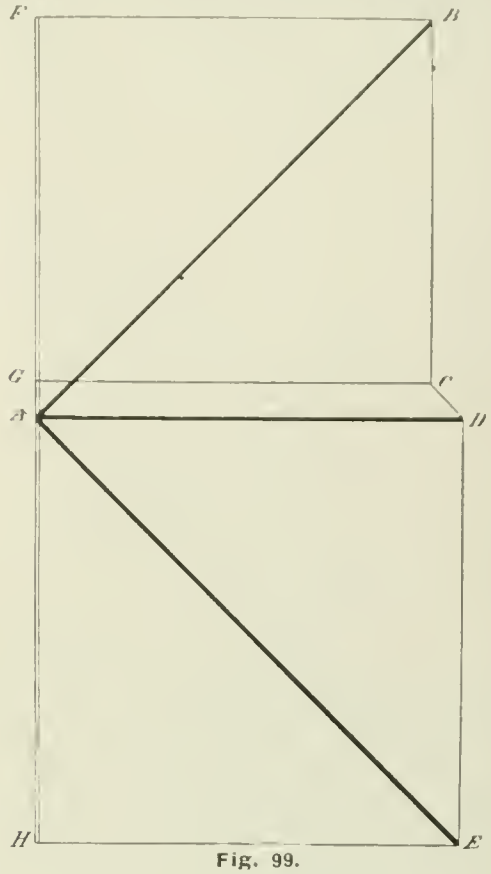


Fig. 99.

in tension and the member BA in compression. (The magnitudes of these stresses will, of course, be given by scaling the lengths of the lines FB and B.A.

**Consider the point BFGC** (Statical Diagram, Fig. 101).

The known force BF (Fig. 101) is exerted by the tension member BF (or FB). This force, is, therefore, equal and opposite to the force exerted by the same member at the point AFB. But FB (Fig. 99) represents the force exerted at the point AFB; therefore, the same line read BF will represent the force BF exerted at the

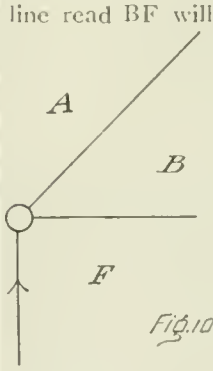


Fig. 100

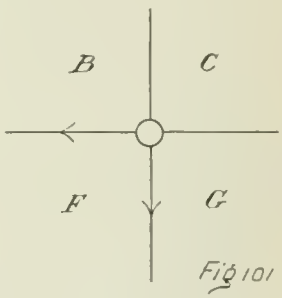


Fig. 101

point BFGC. The line FG (Fig. 99) represents the load FG. (The load FG is less than the reaction AF.) The lines GC and CB complete the polygon, which should then read: BF, FG, GC, and CB. The members GC and CB are evidently both in tension.

**Consider the point ABCD** (Statical Diagram, Fig. 102).

The Vector Polygon for this point reads on Fig. 99: AB, BC, CD, and DA, from which it is seen that the force CD acts away from the point and the force DA against the point. The member CD is, therefore, in tension and the member DA in compression.

**Consider the forces acting at the point ADE** (Statical Diagram, Fig. 103). Referring to Fig. 99, the Vector Polygon for these forces reads: AD, DE, and EA, from which it is seen that the member DE is in tension and the member EA in compression.

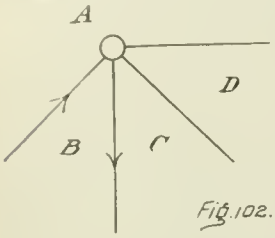


Fig. 102.

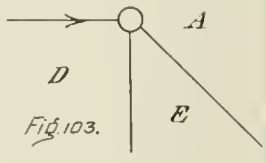


Fig. 103.

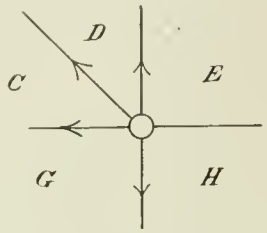


Fig. 104.

Finally, **from a consideration of the point EDCGH** (Statical Diagram, Fig. 104), the member HE is found to be in tension. The Vector Polygon for this point reads on Fig. 99: ED, DC, CG, GH (constructed to represent the load of 1,500 pounds), and HE. (The same result would have been arrived at had the point AEH been considered.)

Fig. 98 represents a Truss, on which the loading is identical to that on the truss, Fig. 97. The Stress Diagram for this last truss is shown at Fig. 105, the construction of which may be seen by considering the various points of the truss in the following order: AFB, ABC, CBFGD, ACDE, EDGH.

## AWARDS FOR WATER AND WATER POWER DIVERSION.

(Continued from page 718.)

Developed Privileges:
(a) Value on Award
(b) Value on Agreement
Undeveloped or Unused Privileges:
(c) Value on Award
(d) Value on Agreement.

Cases in which the prices paid (either on award or agreement) cover not only the power privilege itself, but the taking of large areas of land, mill properties and plants, tenements, etc., have been enclosed in the columns of unit paid by parentheses, and have been omitted from the averages made of these columns.

The general range covered by the data accumulated is shown in the following table:—

| | No. of Cases. | Value per Square Mile of Watershed per Foot of Fall. Max. | Min. | Average. |
|---|---|---|---|---|
| Developed Privileges: | | | | |
| a. By award ..... | 112 | $366.10 | $2.45 | $81.42 |
| b. By agreement ..... | 66 | 181.20 | 2.80 | 54.90 |
| Combined (a and b).... | 178 | 366.10 | 2.45 | 71.55 |
| Undeveloped, unused, or abandoned privileges: | | | | |
| c. By award ..... | 10 | 15.72 | 0.20 | 6.22 |
| d. By agreement ..... | 11 | 25.60 | 1.04 | 8.15 |
| Combined (c and d).... | 21 | 25.60 | 0.20 | 7.23 |

It hardly seems necessary to allude to the fact, which must be patent to any student of this subject, that none of the results submitted can be applied directly to new cases, for the reason that no two cases are identical or even thoroughly similar.

The committee considered carefully the practicability of joint action with the National Cotton Manufacturers' Association, or other organizations of mill owners, relating to the formulation of standard rules of computing or assessing damages for the diversion of water, but reports the impracticability of such action. The questions involved are so much a matter of law, the outgrowth of centuries of experience, and the nature of the problems to be passed upon is so diverse, and the interests involved are so many and even so antagonistic as to make it absolutely hopeless to attempt to formulate, or even to outline, any standard rules as suggested.

## MUNICIPAL PARK IMPROVEMENT.

Many Canadian municipalities have plots of ground set apart for park purposes, but frequently they remain waste and common land when a little planning and the expenditure of a small amount of money would make these parks beauty spots, attractive recreation grounds, and a place for rest and relaxation.

We give in the article two plans of a park at Barrie, Ont. The first sketch shows the park and its general lay out. The second sketch shows how Mr. George H. Miller, a landscape architect, of Boston, Mass., would improve and beautify it. The improvements are planned in relation to the whole town plan and it is to be a "place for mental and the less violent physical exercises, a space reserved for neighborly diversion with congenial uplifting environment, a residential beauty park, a common ground for quietude, refined intercourse, rest and mental recreation, and for such athletic games as will not be competitive between teams having gregarious followings." Provision for athletic fields and playgrounds is to be made in other more suitable locations. Among the features proposed are "the great lawn," "the promenade," "the outdoor auditorium," "the grove," "the flower mall," and "the ravine." Each feature correlates with the other and takes advantage of the natural existing conditions; of the shape of the tract, of topography, tree growth, natural traffic and views. There will be a central dominant feature in the form of a concrete pavilion, and there will be a concrete entrance exedra monumental in design, a concrete bridge and many minor features such as belvederes, a spring-nookery and colonade.

### Mr. Miller's Report.

The planting is used for esthetic and educational purposes and the varieties selected are those known to be hardy in the Barrie region through their being native, tried locally by me, or recommended by the Central Experiment Farm at Ottawa. A great many attractive varieties which might thrive have been omitted from the list, and none included that are not positively determined as above.

The soil condition is especially suitable for a limited number of varieties, such as the Caragana, Corylus, Ceano-

the surface be covered with rotted manure, about twenty cords to an acre in quantity, and that in the spring, immediately before planting time, the same shall be well spaded into the existing soil. This operation should be repeated once a year for at least three years. Precaution should be taken in the bed grading to see that no pools or water pockets are liable to form, for it has been my experience that in such

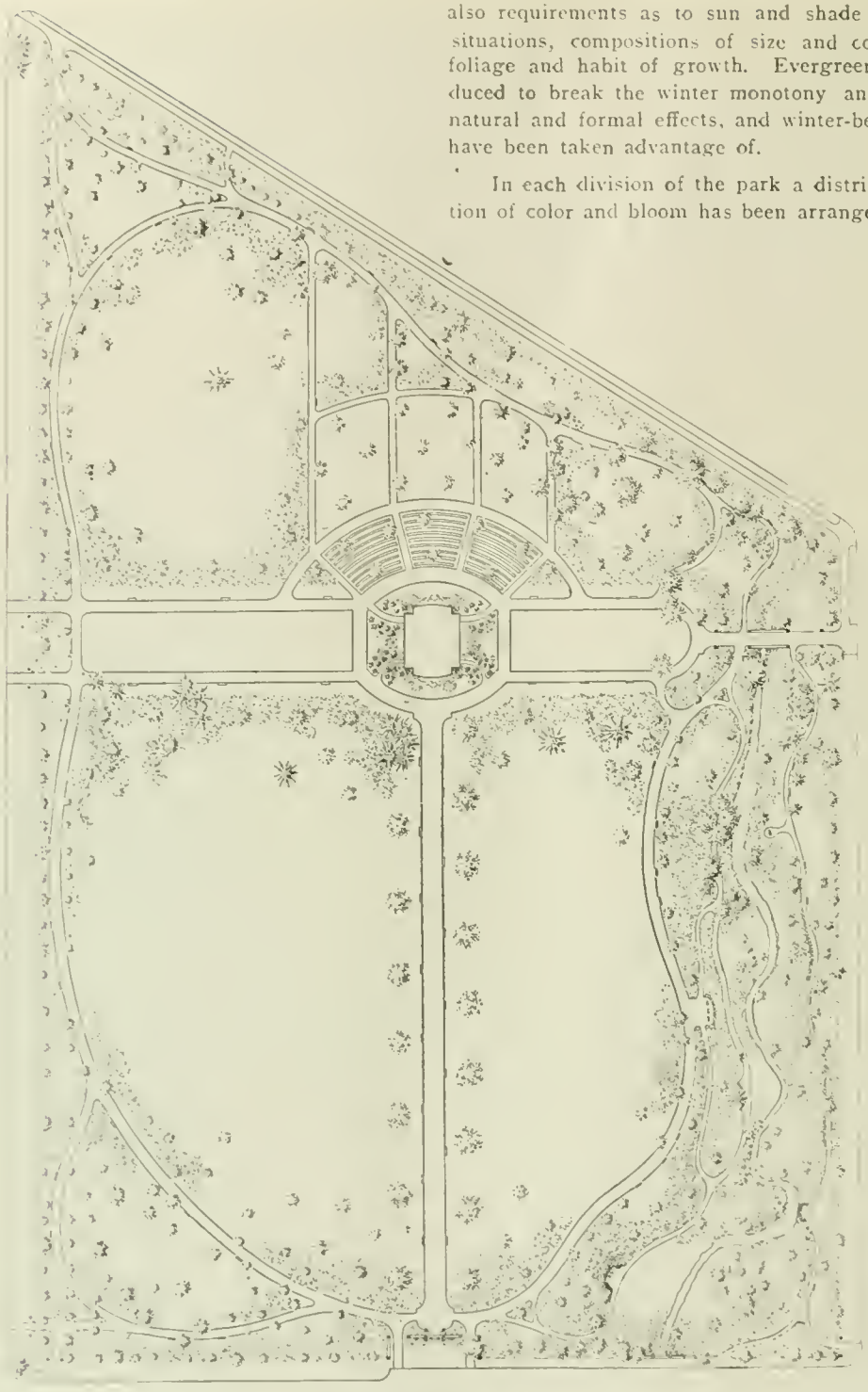
**The Map of Existing Conditions in Queen's Park, Barrie, Ontario.**
Shows much tree growth of natural origin, but planted by the hand of man.

tnus, etc., which flourish in a dry sandy situation. The fact must be recognized, however, that it would be useless to expect any sufficient number of attractive groupings to be arranged that would flourish in the thin, dry, sandy soil surface of this area without some additional nutriment being supplied. I recommend, therefore, that those trees which are to be placed in the open shall be given an initial growing space of three feet in diameter and eighteen inches deep, filled with good loam, and that the unnutritious parts of the soil now in the locations be removed. For the bed areas, I recommend that in the autumn of the year, before planting,

situations, under the soil and climatic conditions given, there is most danger of winter killing. With the prescribed preparation of ground, proper planting and caring for the plants, there is no reason why the plants should not live and develop the desired effects within a few years. The varieties have been selected for these places for which they are naturally suited.

### The Esthetic Purpose.

While the boundaries of the park have been defined by foliage masses, care has been exercised to not injure the views into the park from the surrounding residences and



**The Plan for Arrangements Contains Many Suggestions for adoption by other Municipalities,**

Shows a charming scheme involving little expense for construction because existing features are taken advantage of in an attractive way.

thoroughfares and at the same time to furnish sufficient seclusion within the park, framing the house-gables and shutting out the dirt road-surface of boundary streets as now seen from the park.

The divisions of the park are defined by foliage masses and all the matured existing trees have been taken advantage of and conforming varieties selected to complement them in the groups. In the arrangement consideration has been given to economic values, such as that of binding root formations suitable for holding up the sandy banks of the ravine, also requirements as to sun and shade and moist and dry situations, compositions of size and color and texture of foliage and habit of growth. Evergreens have been introduced to break the winter monotony and are composed for natural and formal effects, and winter-berry and twig-values have been taken advantage of.

In each division of the park a distribution and composition of color and bloom has been arranged and certain striking features made to dominate the division in season. For instance, in "the flower mall," the two straight formal borders will be alive in the spring with the dotted rows of lilac blossoms against the yellow bloom of the taller irregular caragana in back and these will be faced with bridal wreath, the graceful branches of which later when in bloom will form long striking lines of showering white flowers.

The "great lawn," on the other hand, although containing large groups with different colored bloom for different months, is dominated by striking masses of the common

snowball circulated through every portion of its borders, a sight which will enlist the public interest and regard for the beauty of the park and arouse a pride in it and a desire to visit it.

Again, the upper lawn is dominated by hydrangeas planted as border edgings so that the heavy blossoms may droop over to the lawn surface, and there are the white and pink diervillas in the lawn to the northeast, and long strips of Spiraea arguta by the walk leading thereto.

In the ravine, the existing growth and shoulders of the banks prevent long views, and the winding stream channel naturally divides the whole into many parts. These parts are quite defined by the planting groups indicated on planting plan and as far as possible open grass plots have been retained. The purpose of the planting has been to make a series of these parts, each having a different characteristic.

After the trees and shrubs are matured and the park maintenance is on an established basis, the ravine will possess an opportunity for feature planting that will make it famous. I have in mind facing with perennials, biennials and annuals the irregular borders which cover the banks and surround each grass plot, filling the openings or bays in the shrub groups and edges of channel, the varieties to be selected being those which will be in bloom when the shrubs are not, and which planted in quantities will form striking sheets of color. It is purposed that each section shall have a different selection of varieties, and that the varieties should be at least two in number flowering at the same time. For instance, in one section we may have helianthus forming a white sheet of flowers against the darker shade of shrub and tree foliage and before it agreeably contrasted the yellow of the golden glow. In the next section we may have naught but the yellow and blue of the iris at the stream edges or crocuses coming up through the grass, while farther on we may be attracted by other wholesome irregular sheets of red contrasted with the white. And it is intended that this same scheme in variety shall be extended also to all the open spaces in the ravine and smaller lawn openings throughout the park, and that each section shall not be limited to one period of bloom, but rather that it be sufficiently continued to make the whole a veritable garden spot from the beginning to the end of the season and especially when the features on the larger lawn spaces are not the paramount attraction. The perennials used should be those requiring little attention after being once established and they should be of varieties generally wild in nature.

The planting at the main entrance and at the pavilion is mostly evergreen in irregular formality, the dark greens contrasting strikingly with the gray of the architectural features and the bronze shades of the shrubs indicated. This planting must be done with the utmost care and the exercise of taste in the spacing of the plants, for the irregular formal grouping of evergreens is most effectual when properly executed. The arbor vitae are specified as wild plants to be collected in the nearby woods and as far as possible low-branched, well-developed plants should he sought.

### The Educational Purpose.

The educational values of the plants are so many and so obvious that I will only mention a few of the more striking ones that appeal to me as relating to Barrie.

Never in the history of this continent has so much been heard of the conservation of natural resources as now. We read daily the reports of tragic wastes that have been accomplished in the reckless destruction of trees and the resultant exorbitant prices of lumber, resultant expense with which municipalities have been penalized in getting water supplies, and the resultant exhaustion of permanent natural power for industry, the resultant amount of arid land and resultant impairment of natural transportation facilities, and the losses by floods and freshets. The facts are appalling and on their presentation there is a lack of public response which only bespeaks an inability to appreciate the truth.

The great mass of this continental people never has had an appreciation of the value of natural growth with which the lands have been covered, and to-day it is regrettable that there is not a keener awakening, but it is not surprising when one stops to think how little recognition the practical study of the subject has been given by the public authorities. I believe that one of the greatest agencies for preparing the public mind for a sympathetic consideration of the subject is permitting the public to become more intimate with the subject matter, to know trees and natural growth, see the limitations and the time that nature requires to effect a worthy growth, and how easily the process is impaired by the ruthless hand of man. And there is no greater agency through which to bring these things to the sympathetic attention of the great body of the people in our cities and towns who wield so much power in legislation than in having rich masses of this natural growth as part of their daily environment, having it in their own entrustment and on their own public lands where all own, see and know the different varieties being reserved, and for which in this way they may develop an inherent sympathy and respect.

There is also the scientific phase in the aid and encouragement to botanical research as a matter of local enlightenment and contribution to the complete world records. Another educational value is in the demonstration of the individual, collective and relative uses of a considerable number of hardy varieties of trees and shrubs which are mostly native and can be adapted to use on home grounds, a demonstration which satisfies a prospective planter in selecting what he wants and in being sure of what he orders and that he gets what he does order. In this regard I wish to bring to your attention the advisability of having attached to each tree and shrub group an easily seen label bearing the botanical and common name of variety and the source of its nativity. This should prove a great stimulus to the private ornamentation of home grounds and the consequent beautification of the town. Moreover, an acquaintance with the native varieties will make them recognizable in woodlands whence they can be selected with little or no expense.

## NEW INCORPORATIONS

**Ontario**

La Myrrh Chemical Company, Ltd., Georgetown; share capital $100,000.

Carter & Kenney, Ltd., Toronto; $40,000.

Hamilton Ferry Company, Hamilton; $40,000.

Leslie & McNeill, Ltd., St. Mary's; $40,000.

Modern Malleable Range Company, Ltd., Chatham, $40,000.

Cobalt Electric Equipment Company, Ltd., $40,000.

Halls, Ltd., Brockville, $100,000.

New Ontario Slate Company, Ltd., New Liskeard; $500,000.

The Berlin Fuel Savers, Ltd., Berlin; $40,000.

**CONSULT OUR CATALOGUE INDEX** on page 6. We can put you into immediate touch with the principal manufacturers of and dealers in all kinds of engineering and contracting equipment. A postcard to this department will insure the receipt of the desired catalogue.

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Dec. 21 | | STOCK QUOTATIONS TORONTO | | | | | | MONTREAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1909 | 1908 | Price Dec. 23 '08 | Price Dec. 16 '09 | Price Dec 23 '09 | Sales Week End'd Dec23 | Price Dec. 24 08 | Price Dec. 16 09 | Price Dec. 23 '09 | Week End'g Dec 2 | | | | |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,873,000 | 1,597,000 | | 175½ | 180½ | 179½ | 180½ | 179 | 2 | 176¼ | 176⅜ | 180½ | 180⅜ | 179½ | 179 | 924 |
| Canadian Northern Railway | 3,180 | | | 253,700 | 225,100 | | | | | | | | | | | | | | |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | $45,465 | 743,817 | | | | | *1st. pref. 103½, 3rd pref. 50½, ordinary 20½ | | | | | | | | | |
| T. & N. O. | 334 | (Gov. Road) | | 35,526 | 18,009 | | | | | | | | | | | | | | |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 76,565 | 69,296 | | | | | | | | 203 | 201½ | 215¼ | 214½ | 217 | 216⅜ | 941 |
| Toronto Street Railway | 114 | 8,000 | 100 | 82,399 | 73,812 | 108 | 107 | 127 | 126½ | 178 | 107⅞ | 107⅞ | 126⅜ | 126½ | 127 | 126½ | 764 | | |
| Winnipeg Electric | 70 | 6,000 | 100 | | | | 185 | 182½ | | | | | 185 | | 182½ | | | | |
| Halifax Electric | 13.14 | 1,400 | 100 | 3,654 | 3,477 | | | | | | 108 | 106 | 123 | 122⅜ | 123 | 122 | 75 | | |

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

## ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

**Previously Given:—**

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto & York Radial Railway.
Windsor, Essex & Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.
Niagara, St. Catharines and Toronto Railway.
Peterborough Radial Railway.
Berlin and Waterloo.

## SARNIA STREET RAILWAY COMPANY.

President, J. D. Beatty.
Secretary, general manager, superintendent, and purchasing agent, H. W. Mills.
Chief Engineer, William Williams.
**Kind of Road:** Interurban and street.
**Length of Road, in Miles:** Single track, 7 miles.
Double track, 2¼ miles.
Total in single miles, 9¼ miles.
**Character of Service:**
Car equipment No.: 10.
Number of motors, 28.
Method of controlling, ratchet controller.
Method of braking, ratchet brake (Peacock).
Gauge of tracks, 4.8½.
Weight of rails, 56-65-70.
Type, double truck.
Power of motors, 40 h.p.
**Power:**
Direct current.
Voltage of transmission, 500 to 600.
Trolley voltage, 500 to 600.

## COMING MEETINGS.

**Montana Society of Engineers.**—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton, H. Moore, Butte.

**American Society of Engineering Contractors.**—Feb. 24-6, 1910. Annual convention at Chicago, Ill. Secretary, Daniel J. Hauer, Park Row Building, New York, N.Y.

**Indiana Engineering Society.**—January 14-16. Annual convention at Indianapolis, Ind. Secretary, Chas. Brossmann, Union Trust Building, Indianapolis, Ind.

**Michigan Engineering Society.**—January 12-14. Annual meeting at Lansing, Mich. Secretary, Alba L. Holmes, 574 Wealthy Ave., Grand Rapids, Mich.

**Michigan Engineering Society.**—January 12-14. Annual meeting at Lansing, Mich. Secretary, Alba L. Holmes, 574 Wealthy Avenue, Grand Rapids, Mich.

**Indiana Engineering Society.** — January 13-15. Annual convention at Indianapolis, Ind. Secretary, Charles Brossman, Union Trust Building, Indianapolis, Ind.

**American Society of Heating and Ventilating Engineers.**—January 18-20. Annual meeting, New York, N.Y. W. H. Mackay, secretary, P.O. Box 1818, New York, N.Y.

**American Society of Inspectors of Plumbing and Sanitary Engineers.**—January 20-22. Annual convention, Trenton, N.J. C. S. McCosker, secretary, Mobile, Ala.

**National Brick Manufacturers Association.** — February 7-12. Annual convention, Pittsburg, Pa. T. A. Randall, secretary, Indianapolis.

**National Association of Cement Users.**—February 21-25. —Annual meeting, Chicago, Ill. George C. Wright, secretary. Address communications to Edw. E. Krause, Asst. to President, Harrison Building, Philadelphia, Pa.

## SOCIETY NOTES.

**Western Canada Railway Club, Winnipeg.**—The next regular monthly meeting of above club will be held in the Royal Alexandra Hotel, Winnipeg, on Monday evening, January 10th, at 8 o'clock. A paper will be read by Mr. A. E. Cox, Storekeeper, Canadian Northern Railway, on "The Stores Department and its relation to the other departments." There will also be the continued discussion on "Water Supply," and "Copper versus Steel Fireboxes."

**Union of British Columbia Municipalities.**—The following officers were elected for 1 year by the Union of British Columbia Municipalities, at the annual meeting held in North Vancouver, B.C., on December 18th:—President, Mayor Bell, Enderby; vice-president, ex-Mayor Planta, Nanaimo; secretary-treasurer, Reeve Bose, Surrey; Executive Committee, Mayor Hall, Victoria; Mayor Robinson, Kamloops; Reeve Burne, Burnaby; Reeve Quick, Saanich; Reeve McNaughton, North Vancouver; Reeve Evans, Salmon Arm; Reeve Kickbush, Chilliwack.

Some of the resolutions passed were:—

That a committee be appointed to secure all the necessary data dealing with the cement merger question.

That the Dominion government be asked to contribute to roads and bridges in the railway belt, where they draw a revenue from timber lands and water powers.

That the government be asked to appoint a committee of three men familiar with municipal legislation to assist the government in its efforts to simplify and codify the municipal laws of the province.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

## TENDERS.

**Nova Scotia.**

HALIFAX.—Tenders will be received up to January 17th for the purchase of a large lot of second-hand material, the property of the Department of Public Works of Canada, consisting of anchors, propellers, gear wheels, buckets, pins, rollers, castings, engine parts, zinc, copper, rope, plank, tubes, wire rope and sundry other articles stored there. Inspection of goods may be had on application of P. Brown & Son, Church Street, Pictou, N.S. G. M. Graham, Supt. Dredging, Nova Scotia.

**Quebec**

GRANBY.—Tenders for the erection and construction on the racetrack of the "L'Hippodrome Granby Limitee" will be received up to the 7th January. L'Hippodrome Granby Limitee.

**Ontario**

OTTAWA.—Tenders will be received up to January 5th for six hundred and twenty-four tons of steel plates and shapes required at the Government Shipyard at Sorel, P.Q., delivered free. Specifications and detailed information can be obtained from the Purchasing Agent of the Department of Marine and Fisheries, Ottawa, and from the Director of Shipyard, Sorel, P.Q. G. J. Desbarats, Deputy Minister of Marine and Fisheries, Ottawa.

OTTAWA.—Tenders will be received until Tuesday, 18th January, for the supply of timber, hardware, castings, oils, etc., for use on the Welland Canal and its branches for the year 1910. Information may be obtained at the Superintending Engineer's office, St. Catharines, Ont. L. K. Jones, Secretary, Department of Railways and Canals.

STRATFORD.—Until Saturday, January 15th, the city of Stratford wants tenders for two electrically-driven turbine pumps of one million and one and a half million gallons capacity. They should be addressed to Mr. I. Davis Barnett, chairman, water commissioners. Mellis Ferguson is city engineer.

**Manitoba**

WINNIPEG.—Tenders will be received up to Tuesday, January 18, for removing the present superstructure and furnishing and erecting new steel superstructure and floor, complete, for Louise Bridge across the Red River. Plans, specification and forms of tender may be obtained at the office of Colonel Ruttan, the city engineer. M. Peterson, secretary Board of Control.

WINNIPEG.—Tenders for alterations to old post-office building, Winnipeg, will be received until 5 p.m., Tuesday, January 11th. Further information may be obtained on application to Mr. Joseph Greenfield, Resident Superintendent, Public Works Department, Winnipeg, Man., or from Napoleon Tessier, Secretary Department of Public Works, Ottawa, Ont.

WINNIPEG.—Tenders will be received up to Tuesday, February 15th, for the supply and erection of the various portions of the equipment for the terminal station at Winnipeg, and for the turbine governors and gate valves for the generating station. Specifications and plans, etc., may be seen at the office of Messrs. Smith, Kerry & Chace, Confederation Life Building, Toronto, and Carnegie Library Building, Winnipeg. Individual tenders will be received for:—

18. Terminal station.

19 and 20. Step-down transformers and terminal station switching and accessory apparatus.

21. Terminal station, light, heat and power systems.

22. Terminal station, light, heat and power systems.

24. Testing transformers and apparatus.

26. Turbine governors (seven).

27A. Two five-foot gate valves.

M. Peterson, Secretary, Board of Control.

WINNIPEG.—Street Commissioner Tallman recently stated that the Canadian Northern Railway would invite tenders for the construction of the Pembina Street Subway next week.

**British Columbia.**

VANCOUVER.—Tenders are invited by the North Vancouver City Ferries, Limited, for the construction of a double-end steel ferry steamer, 165 feet long, with 29-foot beam until the 20th January. H. E. Kemp, secretary.

VICTORIA.—Tenders are now being invited for the construction of the V., V. and E. line between Abbotsford and Hope, a distance of 78 miles, and also between Princeton and Tulameen. The gap between Tulameen and Hope is to be covered, it is expected, by the proposed eight-mile tunnel.

**U. S. A.**

HEBRON, NEBR.—Tenders for the construction of improvements, extension and enlargement of the Hebron City Waterworks System will be received until January 12th. Instructions to bidders, plans and specifications are on file in the office of O. P. Hess, City Clerk. C. H. Mecker, of McCook, Nebr., is the Engineer.

GUAYAMA, Porto Rico.—Tenders will be received until January 17th for the construction of the Carite Tunnel near Guayama, and the Toro Negro Tunnel near Villalba, the aggregate length of said tunnels being about 6,000 linear feet, and the estimated cost being about $100,000. Plans and specifications may be obtained from the Commissioner of the Interior, San Juan, Porto Rico, from the United States Reclamation Service, Washington, D.C., or from B. M. Hall, Chief Engineer, Porto Rico Irrigation Service by deposit of one dollar.

## CONTRACTS AWARDED.

**Nova Scotia.**

HALIFAX.—At a recent council meeting tenders for 10,000 brick were opened. The General Contractors Supply Company offered them at $7 per 1,000 at the depot or $7.25 at the Cotton Factory Siding. J. Simmonds & Company offered to supply them at $6.95 at the depot and $7.25 at the Cotton Factory siding. Simmonds & Company's tender, delivered at siding, was accepted.

**Quebec.**

HULL.—The William Hamilton Company, of Peterborough, Ont., received the contract for a pump at $14,850 and for additional turbine wheel at $2,315. A complete list of tenders appeared in our issue of last week.

MONTREAL.—Messrs. Laurin & Leitch, of Montreal, were awarded a contract for work on Clark Street and Villeneuve Street at $34,000.

MONTREAL.—Tenders for the construction of a public bath at the corner of St. Dominique and McGuire Streets were opened, and the contract was awarded to the lowest tenderer, D. Lalonde, whose price was $24,448. Five tenders were received for the work as follows: W. Duquette, $28,365; O. Galarneau, $20,497.17; Carriere Company, Ltd., $35,300; J. B. Gratton, $33,800; D. Lalonde, $24,448.

MONTREAL.—The Calkins Tile and Mosaic Company, Ltd., of Montreal, were awarded a contract for tile floor, city hall building, for which the following tenders were received: Calkins Tile & Mosaic Company, Montreal, $840; G. Gilbert, Montreal, $900; A. T. Riopelle, Montreal, $1,350.

**Ontario**

BUXTON.—F. Smithson has been awarded a contract by the Raleigh Township Council for sewer construction at $2,388.

HAMILTON.—M. S. Kappelle was awarded the contract for supplying 40,000 feet of timber for re-decking the Stewart Bridge at $978.96.

TORONTO.—The Polson Iron Works, Toronto, have been awarded a contract by the Toronto Ferry Company for a new ferry boat 185 feet long, 44 feet beam, to carry 2,200 passengers. Contract price, $80,000. The "Bluebell," built last year for the Ferry Company, at the Polson Works, is 150 feet long.

**Alberta**

CALGARY.—The street railway commissioners recommended that the Ottawa Car Company's tender for three car bodies at $2,300 each and Brill trucks for same at $749 each, total $3,145 f.o.b., Ottawa, be accepted, and that the Preston Car and Coach Company's tender for three car bodies at $2,430 each and Brill trucks at $763 each, total $3,193 f.o.b. Preston, be accepted. The difference in these prices, $48, makes the prices equal when the difference in freight in favor of Preston is considered. The commission also recommend that three sets of Canadian Westinghouse brakes be secured at $395 per set, f.o.b. Hamilton, and three sets of Canadian General Electric Company's brakes at $325 per set f.o.b. Peterborough. They advise the acceptance of the Westinghouse Company's tender for controllers, viz.: $333 per car f.o.b. Hamilton. This includes trolley base, motor, cables, controllers and circuit breaker.

EDMONTON.—The McInnis Lumber Company of Edmonton have received a contract for 340,000 ties, 500,000 feet of bridge timber, 150,000 feet of culvert timber and 140,000 fence posts to be used in constructing the first 100 miles of the Alberta & Great Waterways Railway.

**British Columbia.**

VANCOUVER.—Contracts have been let by the British Columbia Electric Railway Company for an auxiliary steam plant. The C. C. Moore Company, of San Francisco, have been awarded a contract for work estimated to cost $250,000, which includes the construction of a reinforced concrete chimney 250 feet high. The Allis-Chalmers-Bullock Company, of Montreal, received an order for the installation of turbine generators of 6,000 horse-power. There will also be special condensing apparatus, a coal-handling machine, and special automatic stoking apparatus, together with an ash conveying machine. It is the intention of the company to dredge the channel of False Creek at the rear of the Westminster Avenue barns, to admit of the entrance of coal barges up to the docks, which are to be built at the back of the new plant at the end of Barnard Street.

**U. S. A.**

BUFFALO (N.Y.).—The Pierce Arrow Motor Car Company has placed a second contract for new buildings with the Aberthaw Construction Company, of Boston. The buildings contracted for late in September are now under roof, and the new contract is for an additional building four storeys in height, 180 feet long, and additions to the power plant. The new buildings will match the rest of the plant in general design and will be absolutely fireproof reinforced concrete construction throughout.

## SEWAGE AND WATERWORKS.

**Ontario**

TORONTO.—At a recent meeting of the Provincial Board of Health, plans for sewage disposal works for the village of Nepigon and the towns of New Liskeard, Oshawa and Kincardine were approved. Plans for a new water system for Gravenhurst were approved.

NORTH TORONTO.—The Board of Health have recommended the town council to take up the question of a sewerage system immediately.

**Manitoba**

WINNIPEG.—The Board of Control, which has been experimenting with ventilators and Webb lamps as a means of deodorizing sewer air, have decided to install the ventilators as cheaper and more efficient. About four hundred will be required for the city, compared to 800 lamps, and the cost will be about $20,000, compared with $200,000 for the lamps.

WINNIPEG.—The Winnipeg Electric Railway company has submitted a plan to the board of control showing a conduit to be constructed in Portage avenue east from the corner of Main and Portage to its Mill street substation to carry return feed wires. This proposal is in line with the recommendation of Prof. L. A. Herdt, of McGill University, Montreal, who has been looking into the danger of damage to city water mains by electrolysis.

**Alberta.**

HIGH RIVER.—Mr. P. Turner-Bone, of Calgary, Alta., has outlined plans in connection with sewerage and waterworks of High River.

**British Columbia**

VICTORIA.—The council have finally decided to submit to the ratepayers, at the forthcoming elections, a by-law to authorize the expenditure of $1,500,000 on the work of developing Sooke Lake as a permanent source of water supply.

VICTORIA.—On January 13th Victoria will vote on a by-law to raise $1,500,000 to bring water from Sooke Lake, a distance of 25 miles. Many are opposed to the measure. The Esquimalt Waterworks Company is getting ready to supply water to Victoria by the gallon from Goldstream, as the present service will have been exhausted before the Sooke scheme can be completed.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec**

MONTREAL.—Work is proceeding favorably with the excavation for the foundations for the big extension to the Canadian Pacific Railway Station on Windsor Street. The contractors, the Foundation Company, of New York and the Bishop Construction Company, of Montreal, have a big plant at work.

MONTREAL.—In order to provide increased terminal facilities for its expanding business, in the east end of the city, the Grand Trunk has, through the Lachine, Jacques Cartier and Maisonneuve Railway (a subsidiary line) made application to the City Council for permission to extend the line of the L. J. C. & M. Railway through the north and east end of the city, to a terminal station which will, for the present, be used primarily for freight business.

MONTREAL.—The work of construction of the extension of the Quebec Central Railway from St. George, Beauce, to St. Justine, a distance of thirty miles, has practically been completed. Twenty-eight miles of track are now laid to St. Justine, and it is expected that the line will be opened to regular train service after the first of January next. The Quebec Government engineer, Mr. L. A. Vallee, made his inspection of the first twenty miles in the early part of this month, and expressed himself as well pleased with the line.

**Ontario**

LONDON.—The Grand Valley Railway and the Cataract Power Company are said to be preparing to purchase the Southwestern Traction Company and the London Electric Company. The plan also includes the extension of the radial railway line now connecting Brantford and Hamilton through to Woodstock and Ingersoll to this city, thence connecting with a steamship service to Port Stanley; and also to transmit Niagara power for general consumption along the route.

LONDON.—The Canadian Pacific Railway is considering the construction of a new roundhouse here next spring, among other improvements and extensions, which include the enlargement of the yards.

**Manitoba.**

WINNIPEG.—Three new branches of the C.P.R. are now being opened for passenger traffic. These include the extension of the Lacombe branch, from Stettler to Castor; the opening of the Weyburn to Forward line, and the opening of a new line from Lethbridge to Carmingay. The line running east from Stettler will eventually pass through to Outlook and constitute a main line between Moose Jaw and Edmonton.

**Alberta**

EDMONTON.—The C.N.R. line will be extended to Athabasca Landing, thirty-six miles from Morinville, the present terminus.

EDMONTON.—Mr. W. R. Clarke, president of the Alberta & Great Waterways Railway, recently intimated that construction work would commence as early as possible in the spring. Four survey parties are out and it is expected that two hundred miles will be graded next season.

EDMONTON.—The Canadian Northern Railway have given assurance to the provincial government that it is their intention to extend next year their Morinville line to Athabasca Landing, and to put the extension into operation. There are but thirty-six miles to complete to reach the Landing. Contracts totalling many thousands of dollars for the supply of ties, bridge timber, culvert timber, and fence posts for the construction of the first 100 miles of the Alberta and Great Waterways Railway were awarded this week to McInnis Lumber Co., of Edmonton. Similar contracts covering fifty miles of right of way were awarded to James Walker, of Fort Saskatchewan. The combined contracts will cover all timber necessary for construction of entire line as far north as Lac La Biche. The contracts awarded to the McInnis Company will require employment of at least 400 men to rush the work through before spring. Work has already been commenced and the first gang was despatched on December 21st, to the first camp thirty-five miles north of the city. The McInnis contracts call for the supply of 340,000 ties, 500,000 feet of bridge timber, 150,000 feet of culvert timber and 140,000 fence posts.

**British Columbia**

NEW WESTMINSTER.—The inclement weather has somewhat delayed construction on the New Westminster-Chilliwack line; but the line of steel, which will connect the two places, has been advanced past the 25-mile post, while contractors' gangs are busy on the other side building the roadbed. It is reported that some slight engineering difficulties have been encountered at Matsqui slough some thirty miles from here.

VANCOUVER.—Construction of the coast section of the V. V. & E. Railway, which will cross Hope mountains via the Coquehalla divide and join the Similkameen extension of the road from Princeton, will commence next spring. This is the opinion of the contractors who returned to Vancouver this week, after having looked over the route of the proposed line prior to submitting tenders for the work. Those who made the journey were A. Jellett of Spokane, representing the contracting firm of P. Welch & Company, and Charles Folliot, representing Guthrie & Company, contractors of St. Paul. A representative of the Vancouver contracting firm of Ironside, Rannie and Campbell also went over the ground. The party was piloted by J. H. Kennedy, chief engineer of the Hill railway. The entire Coquehalla river, was thoroughly covered, the party traversing it over the old Yale road, which in its general trend follows the route to be taken by the line. No serious construction difficulties were encountered. It is understood that tenders will be acted upon early in the new year and that construction will be in full swing by spring. Determination of the manner in which the Hope range will be crossed has not yet been made. It is reported that this question is now occupying the attention of the engineers.

## LIGHT, HEAT, AND POWER

**New Brunswick.**

MONCTON.—New Brunswick Wire Fence Company at a recent annual meeting elected Mr. A. C. Chapman, secretary and manager, and decided to install their own power plant.

**British Columbia**

KAMLOOPS.—This city is making additions to its lighting plant, which will be one of the largest and most complete in interior British Columbia.

## FINANCING PUBLIC WORKS.

Debentures were sold as follows during the past few days:—

**Newmarket, Ont.**—$20,000, permanent improvements.
**Georgetown, Ont.**—$3,150, local improvements.
**Pictou, N.S.**—$9,000, paving.
**Miniota, Man.**—$12,000.
**Pipestone, Man.**—$25,000.
**Claresholm S.D., Alta.**—$7,000.
**Lacombe, Alta.**—$25,000.
**Halbrite, Sask.**—$3,000, permanent improvements.
**New Westminster, B.C.**—$400,000 waterworks, etc.
**Richmond, B.C.**—No tender was accepted for $150,000 debentures.

**Quebec**

JONQUIERES, CHICOUTIMI COUNTY.—This municipality offers for sale $12,000 waterworks debentures.

**Ontario**

HALTON COUNTY.—M. C. Smith of Burlington, Ont., offers for sale until January 5th, debentures amounting to $16,000 issued by this municipality.

MEAFORD.—The ratepayers will vote on a $30,000 new public school by-law.

ARNPRIOR.—The ratepayers will vote on a $7,117 local improvement by-law, and a by-law for the construction of granolithic walks, macadam roads and sewers.

**Manitoba**

BRANDON.—Ratepayers have sanctioned the by-law to authorize the issue of $10,000 bonds for improving streets leading to the city.

KILLARNEY.—A by-law to complete the town hall at a cost of $10,000 has been carried.

STONEWALL.—The $10,000 by-law and the parks by-law were carried.

WINNIPEG.—Of the three by-laws recently submitted to the ratepayers the $50,000 art gallery was defeated. The $150,000 for underground conduits, etc., and the $50,000 for municipal baths, were carried.

ST. BONIFACE.—The electric light, gas and parks by-laws were all defeated.

**Alberta**

WETASKIWIN.—Both the hospital by-law, $30,000 and the parks by-law, $2,000 were defeated.

**British Columbia.**

NANAIMO.—A by-law to authorize the borrowing of $100,000 for the installation of a sewerage system will be submitted on January 13th.

## CURRENT NEWS.

**Nova Scotia.**

HALIFAX.—At a meeting of the Board of City Works the estimates of the department for 1910-11 were adopted. They include: Cleaning paved streets, $5,500; streets, $25,000; internal health, $17,000; lighting streets, $23,800.

**New Brunswick.**

MONCTON.—The New Brunswick Petroleum Company have discovered natural gas in large quantities twelve miles from here, and it is proposed to lay pipes to Moncton.

**Ontario**

HAMILTON.—Plans for building a bridge over Lottridge Inlet, at an estimated cost of $2,000 have been approved. Andrew F. Macallum, city engineer.

TORONTO.—Under the name of the Canada Bolt and Nut Company, Ltd., the Toronto Bolt & Forging Company, Swansea; the Brantford Screw Company, Brantford; the Gananoque Bolt Company, Ltd., Gananoque, and a rolling mill at Belleville have been amalgamated. The president of the amalgamated companies is Mr. Lloyd Harris, M.P., Brantford. The Swansea works are likely to be enlarged.

OTTAWA.—The New Wellington Street viaduct was formally declared open for traffic last week.

Municipal Water Commissioners for 1910 have been elected by acclamation as follows:—

**Stratford, Ont.**—J. D. Barnett.
**Galt, Ont.**—A. J. Oliver.
**Listowel, Ont.**—Jacob Bray.
**Peterborough, Ont.**—W. H. Moore (three years).
**Petrolea, Ont.**—G. S. Pitkin.
**Dunnville, Ont.**—Mr. O. E. Wilson.

## MISCELLANEOUS.

**New Brunswick**

ST. JOHN.—The construction of the Navy Island bridge at an estimated cost of $749,577 will probably be considered at the January meeting of the city council.

**Quebec.**

MONTREAL.—The Montreal Street Railway is asking for permission to extend its lines.

MONTREAL.—The by-law asking whether the corporation should establish a municipal electric lighting plant at a cost of two million dollars was carried.

MONTREAL.—Tenants of the block at the corner of St. James and St. Francois Xavier Street and the lessees of St. Lawrence Hall Hotel, which is owned by the Canadian Pacific Railway Company, have been served with vacation notices, which become effective on March 1st next, when the demolition of the present buildings will begin, and arrangements will be made for its replacement by a new ten-storey modern fireproof structure.

SHERBROOKE.—The council have been asked by the ratepayers of the East Ward to replace the old Alymer bridge with an up-to-date structure.

THREE RIVERS.—Canada Iron Corporation have decided to rebuild their iron pipe foundry which was destroyed by fire several weeks ago.

**Ontario.**

BRAMPTON.—On January 3rd, ratepayers here will probably sanction a by-law to raise $40,000 for the installation of a plant to distribute Hydro-electric power.

OTTAWA.—The tenders recently submitted for the removal of the wreckage of the Quebec Bridge have been found unsatisfactory, and an endeavor will be made to make a contract privately. A fair estimate of what the work should cost is placed at $50,000. Several of the bids, however, were much in excess of this figure, and others had conditions attached to them which could not be entertained.

TORONTO.—City Engineer Rust has recommended the construction of a new bridge on the Weston Road at West Toronto.

TORONTO.—A quantity of standing timber on Rondeau Provincial Park, County of Kent, Ont., is offered for sale by public tender on Monday, 3rd January, consisting of basswood, ash, elm, beech, maple, oak, hickory, and other kinds of mature timber or timber requiring to be cut and removed in the proper management of the forest. Mr. F. Cochrane, Minister of Lands, Forests and Mines.

TORONTO.—The new provincial wagon road between Elk Lake and Gow Ganda, 27 miles, has been completed and is now open. The new road save five miles on the winter road and can be used both winter and summer.

TORONTO.—A British manufacturer of brass and iron goods generally requires a Canadian agent. Write Box 56, Canadian Engineer office for further particulars.

**Manitoba.**

KILLARNEY. The installation of a heating plant in the town hall, to cost about $3,000 is being considered. G. B. Monteith, town clerk.

WINNIPEG.—By-laws for baths and conduits have been sanctioned.

**Alberta**

EDMONTON.—Surveys are completed for the construction of a proposed hydro-electric power plant on the Saskatchewan River, developing 20,000 horse-power, at an initial cost of $1,500,000. Mr. Charles Tupper, B.Sc., and Mr. Charles H. Colgrove, M.E., have outlined plans.

**British Columbia.**

VICTORIA.—The Provincial Government has declined to advance $75,000 for the installation of an electric light plant and equipment at Prince Rupert.

## PERSONAL NOTES.

MR. C. H. B. TOPP, city engineer of Victoria, B.C., has resigned to accept another position.

MR. GEORGE E. GRAHAM, superintendent of Canadian Pacific Railway terminals at Fort William, Ont., has been transferred to Vancouver, B.C., where he will assume the office of District Superintendent.

MR. ARTHUR E. FREEMAN has opened an office at 514 Continental Life Building, Toronto, Ontario, for the practice of Consulting Engineering along the lines of Heating, Ventilating, Sanitary Plumbing, Mechanical, Electrical and Illuminating Engineering.

DR. HENRY T. BOVEY, F.R.S., tendered his resignation as rector of the Imperial College of Science and Technology at a recent meeting. It is understood that this step has been taken owing to the condition of Dr. Bovey's health. The resignation, which came as a great surprise, was accepted with the deepest regret, and reference was made to the rector's great devotion to, and keen interest in, the important work which he had so recently undertaken, and to his unfailing courtesy and consideration in his dealings with all. Dr. Bovey, who was appointed rector in May of last year, is well known to all Canadians and Anglo-Canadians, having previously been Dean of the Faculty of Applied Science at McGill University. Dr. Bovey came to Canada in 1877, on his appointment as Professor of Civil Engineering and Applied Mechanics at McGill. At that time the engineering courses in the University were managed as a branch of the Faculty of Arts, and were without buildings or equipment. The following year, however, a department of applied science was constituted, with Professor Bovey as dean, and to his management and advice the science department owes its development. He was one of the founders of the Canadian Society of Civil Engineers. Dr. Bovey married the youngest daughter of the late Mr. John Redpath, of Montreal. Among his publications are "Applied Mechanics," "Theory of Structures and Strength of Materials," and "Hydraulics."

## MARKET CONDITIONS.

Montreal, December 29th, 1909.

There has been practically no change in the American pig-iron situation, save that the past few days has witnessed a disposition towards a fresh buying movement. There are no longer claims of a heavy tonnage being turned over, but it is stated that enquiries are better than they have been for some time past. Many well informed people are looking forward to a buying movement after the new year, and these would not be surprised to see some advances in price. There is quite a little activity in structural steel material for building purposes, and good orders were recently reported for locomotives and steel cars. In reality the general situation has been but little altered by all this, and the general tone of trade is quiet as compared with the previous activity. The belief in Montreal seems to be that the trade need not look forward to any special activity for some weeks yet.

Trade in Great Britain has shown an unexpected and decided improvement, during the past week. All grades of pig-iron have advanced to some extent and low phosphorous metals, suitable for steel making purposes, have risen 5s. to 6s. per ton, foundry grades having gone up about 3s. per ton. The upward movement is due to the fact that orders have recently been placed for the construction of several large ships, involving the use of considerable tonnage of structural material, steel plates, etc. In addition to this, there is a better feeling, generally. Raw material has continued to advance and British users of low phosphorus ores, who have, for several months, been withholding the placing of orders, in the hope of securing new supplies for 1910 at 1909 prices, now recognize that they must pay the advance not only in ore but in coke. They are, therefore, advancing their ideas regarding pig-iron to correspond with enhanced cost of production. Billets and all semi-finished material have advanced in practically the same ratio as pig-iron, and it is expected that finished goods will take a correspondingly high level. The German and Belgian markets are in better condition than they have been for several months past, prices of all classes of iron and steel material having shown advances; there is still a disposition on the part of makers to decline to quote for deliveries extending into the future. In a general way, the conditions of the iron and steel trade throughout the world are now in better shape than they have been for two years past.

So far as Canada is concerned, the volume of business is good. Prices are being well maintained, stocks are very low and orders received are sufficient to keep plants operating to the fullest extent. The outlook for the future is bright. It is thought, in Montreal, that, while there may be set-backs, they will be of but a temporary nature and will be followed by increased activity.

At the present time, trade in finished and semi-finished goods is anything but active and the market, throughout, appears to be absolutely steady, so far as prices are concerned. The feeling, however, is that early in 1910 there will be a readjustment, upwards.

**Antimony.**—The market is steady at 8 to 8½c.

**Bar Iron and Steel.**—The market promises an advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.00 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal

**Copper.**—Prices are strong at 14 to 14½c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to

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